SPECIFICATION

FOR

POWER PLANT EQUIPMENT

OF THE

NEW BUILDINGS

FOR THE

UNITED STATES DEPARTMENT OF AGRICULTURE,

WASHINGTON, D. C.

JAMES WILSON, Secretary of Agriculture.

BUILDING COMMITTEE.

B. T. GALLOWAY, Chairman. A. C. TRUE. GIFFORD PINCHOT

JOHN STEPHEN SEWELL, Supervising Engineer.

R. BARNARD TALCOTT, S. FRANKLIN GARDNER,
Mechanical Engineers.

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ADVERTISEMENT.

OFFICE OF THE BUILDING COMMITTEE,
U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C. January 31, 1907.

Sealed proposals will be received at this office until 2 o'clock p. m. on the 12th day of March, 1907, and then opened, for the power plant equipment of the new buildings for the United States Department of Agriculture, Washington, D. C., in accordance with the drawings and specifications, copies of which may be obtained at the Office of the Building Committee, United States Department of Agriculture.

All applications must be accompanied by a certified check for $100, made payable to the Disbursing Clerk of the Department of Agriculture, which checks will be retained until the return of the drawings and specifications.

B. T. GALLOWAY,
Chairman.

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SPECIFICATION

FOR THE

POWER PLANT EQUIPMENT OF THE NEW BUILDINGS FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

SECTION I.—GENERAL CONDITIONS.

Form of Proposal and Signature.

1. Proposal must be made on the blank form hereto attached, plainly marked "Proposal for Power Plant Equipment of New Buildings," on the envelope or cover, and addressed to the Chairman of the Building Committee, United States Department of Agriculture, Washington, D. C., stating in writing and figures (without interlineation, alteration, or erasure) the sum of money for which the bidder proposes to supply the materials and perform the work required by the drawings and specification, the separate prices called for in proposal sheet, and also prices of certain parts of the work. The proposal must be signed with the full name and address of the bidder; if a copartnership, the copartnership name by a member of the firm, with names and addresses in full of each member; and if a corporation, by an officer in the corporate name, with the corporate seal attached to signature. No telegraphic proposals or telegraphic modifications of proposals will be considered. Proposals received after the time advertised for the opening will be returned unopened. If a proposal is sent by registered mail, allowance should be made for the additional time required for such transmission.

Certified Check.

2. Each bidder must submit with his proposal a certified check, in amount $2,000, drawn to the order of the Disbursing Clerk of the Department of Agriculture, and the proceeds of the said check shall become the property of the United States if for any reason whatever the bidder, after the opening of the bids, withdraws from the competition or refuses to execute the contract and bond required, in the event of such contract being awarded to him. Checks submitted by the unsuccessful bidders will be returned after the approval of the contract and bond executed by the successful bidder.

Eight-hour Law.

3. The attention of bidders is called to the Act of Congress, approved August 1, 1892, limiting the hours of daily service of laborers and mechanics employed upon public works of the United States to eight hours in any one calendar day.

Convict Labor.

4. In compliance with Executive order dated May 18, 1905, convict labor must not be employed in connection with this contract.

Subcontractors.

5. No subcontractor or other person furnishing material or labor will be recognized, nor will the United States be responsible in any way for the claims of such persons beyond taking a bond, with good and sufficient sureties, with the additional obligation that the general contractor shall make prompt payment to all persons furnishing him labor or materials used in the prosecution of the work. Persons so furnishing materials or labor to have a right of action on said bond, in the name of the United States for their use.

Designation of Parties.

6. The contracting officer, on the part of the United States, is the Secretary of Agriculture; the officer appointed by him to act as contracting officer is designated in these specifications as "Supervising Engineer." The present incumbent of this office is Capt. John Stephen Sewell, Corps of Engineers, U. S. Army.

7. The engineers appointed by the Secretary of Agriculture for the designing and superintending of the mechanical equipment of the buildings are R. Barnard Talcott, consulting mechanical engineer, and S. Franklin Gardner, mechanical engineer and superintendent.

8. All matters pertaining to the installation of the mechanical work are to be handled by the mechanical engineer and superintendent, acting in consultation with the consulting mechanical engineer. All matters, however, involving modifications in contract, and payments thereon, must be approved by the supervising engineer.

9. Wherever the word "contractor" is used herein it shall be held to mean any individual or firm of individuals, or any corporation, who may contract with the United States to do the work or furnish materials under this specification. Wherever the word "bidder" is used herein it shall be held to mean any individual or firm of individuals, or any member of any firm or any corporation signing a bid submitted.

Routine of Business.

10. After the award and signing of the contract, all business relating to the work shall be transacted through the office of the mechanical engineer and superintendent, except as otherwise herein provided.

Rights Reserved.

11. The materials proposed to be used, time for completion of the work, and the competency and responsibility of bidders will receive consideration before award of contract.

12. The Department reserves the right to accept any part or parts of the proposal made at the prices included in same; also to waive any informalities in and to reject any and all proposals.

Form of Contract.

13. The contract which the bidder agrees to enter into shall be in form based upon the terms of this specification.

Bond.

14. The successful bidder must furnish a bond in a sum equal to 50 per cent of the amount of the contract, with sureties satisfactory to the Department, guaranteeing the fulfillment of all provisions of the contract, the satisfactory completion of the work included therein within the stipulated time, the prompt payment of all persons furnishing materials or labor required in the execution of the work, and covering all guarantees herein provided for.

15. No payment will be made on this contract until the bond has been submitted to the Department and approved by the Secretary of Agriculture.

16. The contractor must obtain, at his expense, all necessary policies of insurance on work and materials supplied by him, as the same will be at his risk until final completion, inspection, and acceptance.

Modifications.

17. The Department reserves the right to make any additions to, omissions from, or changes in the work or materials called for by the drawings and specifications, without notice to the surety or sureties on the bond given to secure satisfactory compliance with the terms of the contract; and the United States further reserves the right to demand additional security when additions are made, if in the judgment of the supervising engineer such security is required. For such additions, omissions, or changes the contractor must submit a reasonable proposal. If the proposals submitted

are deemed unreasonable by the supervising engineer, he shall, acting for the United States, have the right to fix the value of such additions, omissions, or changes, and no claim for damages on account of such changes or anticipated profits shall be allowed.

Delays.

18. Each bidder must submit his proposal with the distinct understanding that, in case of its acceptance, time for the completion of the work shall be considered as the essence of the contract, and that for the cost of all extra inspection, salaries, and other expenses entailed upon the United States by delay in completing the contract, the United States shall be entitled to a fixed sum of $25 as liquidated damages, computed, estimated, and agreed upon, for each and every day's delay not caused by the United States.

19. *Provided*, That the collection of said sum may, in the discretion of the Secretary of Agriculture, be waived in whole or in part, and that the contractor shall be entitled to one day, in addition to said stipulated time, for each day's delay that may be caused by the United States or may be due to causes which could not have been foreseen or prevented by the contractor.

20. The supervising engineer, acting for the United States, reserves the right to suspend any portion of the work embraced in the contract whenever, in his opinion, it would be inexpedient to carry on said work.

Notice to Sureties.

21. The final inspection and acceptance of the work shown by the drawings and specifications, forming a part of the contract, shall not be binding or conclusive upon the United States if it shall subsequently appear that the contractor has willfully or fraudulently, or through collusion with a representative or official of the United States on the work, supplied inferior materials or workmanship, or has departed from the terms of his contract. In any such case the United States shall have the right, notwithstanding such final acceptance and payment, to cause the work to be properly performed and satisfactory material supplied to such extent as in the opinion of the mechanical engineer may be necessary to finish the work in accordance with the drawings and specifications therefor at the cost and expense of the contractor and the sureties on his bond, and shall have the right to recover against the contractor and his sureties the cost of such work, together with such other damages as the United States may suffer because of the default of the contractor in the premises, the same as though such acceptance and final payment had not been made.

Payments.

22. Payments of 90 per cent of the value of the work executed and satisfactorily in place, based upon the estimated value thereof as ascertained by the supervising engineer, will be made every thirty or sixty days, or as may be provided in the contract, and the payment of the 10 per cent retained will be made after the final approval and acceptance by the supervising engineer of all work and materials embraced in the contract.

23. The supervising engineer, however, shall have the right to suspend payments at any time if in his judgment the contractor is not using due diligence to procure and submit for approval satisfactory samples as required by the contract, and is not prosecuting his work as promptly as conditions demand.

24. To aid the supervising engineer in ascertaining the value of work done and in place, the contractor shall furnish to the said official, before any payment shall be due, a schedule of prices upon which the contract is based.

Supervision.

25. Every part of the work is to be executed under the direction and to the entire satisfaction of the mechanical engineer, and subject to the final approval and acceptance of the supervising engineer.

Measurements.

26. Bidders should visit the buildings in order to get a satisfactory comprehension of the work required and make such measurements as they may desire, as the drawings accompanying this specification are not intended to be scaled.

Time to Complete.

27. The work under this contract must be begun as soon, and prosecuted as fast, as conditions will permit, under the direction of the mechanical engineer, and at such times as will avoid interference with other contracts, and must be completed not later than October 15, 1907.

Patents.

28. The Department will not recognize any demand brought on account of infringement of patents; but will hold the contractor and his bondsmen strictly responsible for any delay or cost resulting from his failure to fully protect the United States against patent rights.

Tools and Appliances.

29. All tools and appliances required for the proper execution of the work must be provided by the contractor and be maintained, used, stored, and moved at his expense and risk.

Lighting.

30. Contractor must furnish and maintain all artificial lights necessary for the proper execution of the work.

Cuttings, Restoration, and Removal of Débris.

31. Contractor shall at his expense do all necessary cutting, drilling, etc., repair in the best possible manner, under the direction of the mechanical engineer, any damage to his own or others' work and materials incident to his contract, and remove from the premises all débris resulting from the execution of his contract.

Inspection and Acceptance of Work.

32. Any materials delivered or work performed by the contractor, at any and all times during the progress of the work and prior to its final acceptance and the payments therefor, shall be subject to the inspection of the mechanical engineer, who shall reject any part that in his opinion is not strictly in accordance with the contract.

Tests.

33. After the completion or during the progress of the work the Department shall authorize such tests of the installations to be made as may be considered necessary. If these tests show that the work does not comply with the specification requirements, the contractor must immediately make all changes necessary to put the work in proper condition, and shall pay the expenses of all subsequent tests and inspections required to determine whether or not the work is satisfactory.

34. In case the contractor fails to make, within a reasonable time, such changes as are demanded by the mechanical engineer, the supervising engineer reserves the right to have such changes made at the contractor's expense.

Personal Interview.

35. The right is reserved to require the contractor or his authorized representative to visit the Department, without expense to the United States, if at any time it is considered that, in the interest of the United States, a conference is necessary for the prompt adjustment of any complicated or unsatisfactory conditions that have developed in connection with this contract. Any understanding arrived at as a result of such conference shall not be binding until formally approved.

Interpretation of the Specification.

36. In all questions relating to the interpretation of this specification or any part thereof, the decision of the mechanical engineer, concurred in by the supervising engineer, shall be final.

Foreman, etc.

37. The work shall at all times be conducted in charge of a competent superintendent or foreman, who shall represent the contractor and have general authority to act for him, and the contractor shall discharge and not employ upon this work any foreman or any and all workmen whom the supervising engineer may deem incompetent or careless. The contractor shall also give his personal attention to the work.

Materials and Workmanship.

38. All materials and appliances used under this contract, unless specifically described, shall be of best grade of standard manufacture, and all workmanship shall be strictly first-class.

39. The bidders are required to fill out on the proposal sheet the clauses relating to materials and appliances which they propose to use; also to give the name and address of manufacturers of special appliances required under this contract.

40. Should bidder fail to submit such a list of materials and appliances, or in the event the materials and appliances named on the proposal sheet in any case are considered unsatisfactory, the Department reserves the right to name articles and materials which will conform to the specification, and the selection by the Department shall be final and binding upon the contractor.

Samples.

41. The Department reserves the right to require the contractor to submit samples of any or all articles or materials to be used under this contract, which samples, if approved, may be used on the work after serving their purpose as samples.

42. Samples, if requested, must be received in ample time for their proper consideration and approval, and for the execution of the work thereafter within the contract time for completion.

43. In the event the contractor delays the submission of samples when called for, so that there does not appear to remain sufficient time for the execution of the work, the Department reserves the right to abrogate the contract or to purchase materials and have the work performed at the expense of the contractor.

Approval of Appliances.

44. The approval of any appliances or materials named or submitted by the contractor is to be understood as subject to the specification requirements, and not as an absolute acceptance.

Construction of Power House and Tunnels.

45. The power house is to be constructed with brick outside and partition walls, the floors being of solid or reenforced-concrete construction. The side walls and floor of tunnels to be of solid concrete construction and the roof to be of reenforced-concrete construction.

SECTION II.—GENERAL DESCRIPTION.

Scope of Work.

46. This specification with accompanying drawings is to describe a complete power plant equipment, including boiler plant, generating units, switchboard, air compressors, pumps, heaters, tanks, piping, distilled-water apparatus, etc., including tunnel piping and electric cable connections to the two laboratory buildings, as shown on the drawings and as hereinafter specified in detail. Drawings Nos. P. P. 401 to P. P. 410, inclusive, show the complete layout of the power plant and piping systems, and proposals submitted must be based on these drawings.

Explanation of Drawings and Specifications.

47. The drawings are to be taken together with the specifications and not separately, and should there exist any discrepancies between them, the contractor shall apply to the mechanical engineer for further and particular instructions for each case, and failing to do so shall make the work right at his own expense, to the satisfaction of the mechanical engineer.

SECTION III.—ENGINE EQUIPMENT.

TURBINES.

Requirements.

48. This specification is to provide complete in every detail steam turbines of the latest and most approved design, having extra-heavy frames and especially adapted for direct connection to generators, to be located in engine room as indicated on drawing No. P. P. 401.

Number and Type.

49. This specification is to cover three turbines, each connected to a generator, two of the generators to be 150 K. W. generators, one to be a 75 K. W. generator. The turbines are to be of horizontal pattern with generators mounted on turbine shaft extended, designed to run at a steam pressure of 125 pounds per square inch and a back pressure of approximately 2 pounds per square inch, or to exhaust into the atmosphere.

50. The turbines must be proportioned to operate satisfactorily the generators at 30 per cent overload, the revolutions of the turbine shaft in no case being over 2,000 revolutions per minute for the 150 K. W. units and 2,400 revolutions per minute for the 75 K. W. unit.

Steam Consumption.

51. Bidders must give on their proposal sheet the guaranteed steam consumption for the two sizes of turbines, based on the number of pounds of steam per kilowatt hour for $1\frac{1}{4}$ load, full load, $\frac{3}{4}$ load, $\frac{1}{2}$ load, and $\frac{1}{4}$ load.

Tests.

52. Shop tests of the three turbines are to be made to determine the steam consumption at the different loads, speed regulation, etc., by the mechanical engineer.

53. The contractor must notify the mechanical engineer when the turbines are ready for test and must furnish all apparatus necessary for the tests, and pay all expenses incident thereto.

54. The shop tests may be omitted, if desired by the mechanical engineer, and such tests as may be considered advisable by the mechanical engineer made after their erection in the building.

Regulation.

55. The speed regulation of the turbines must be such that under no condition of change of load from full load to no load will the speed vary more than 2 per cent from the average speed.

Construction Details.

56. Every part of the turbines must be of heavy pattern and design, constructed in each case of materials best adapted for the various parts in accordance with the most modern practice.

57. The frames are to be of extra-heavy pattern, having substantial bases extended for supporting the generators and securely bolted to foundations.

58. All moving parts must be properly balanced, fitting bearings accurately, and provision must be made for preventing interference of the moving and stationary vanes by a slight end movement of the shaft or by expansion or contraction of the different parts.

Fittings.

59. Turbines are to be equipped with extra-heavy throttle valves suitable for 250 pounds pressure per square inch, of design best suited to the machines furnished.

60. Each turbine is to be furnished with an emergency governor independent of the regular governing apparatus, which shall quickly shut off the steam supply when the speed exceeds a fixed amount above normal.

61. All necessary drip and drain connections, with valves, are to be provided, connecting with the drip mains, in exhaust-pipe trenches. Exposed drip piping, valves, etc., to be finished brass, nickel-plated.

62. The turbines are to be provided with sheet-steel lagging, put on in an improved manner.

63. One complete set for each turbine of single-ended, drop-forged, steel wrenches, to fit all the various nuts, is to be provided and placed in a metal rack to be furnished and located where directed.

Lubrication.

64. A complete mechanically operated oiling system, consisting of reservoir, all necessary sight-feed lubricators, force pump, piping, etc., to be provided for each machine. All lubricating cups, valves, piping, etc., to be finished brass, nickel-plated.

Foundations.

65. The turbines and generators are to be securely bolted to concrete foundations extending to just below the floor line, three courses of brick to be provided on top of concrete. The foundations are to be installed by this contractor and must conform, as to materials, to the requirements hereinafter specified.

Specifications and Drawings.

66. Bidders must state in their proposals the make of turbine upon which their proposal is based and must submit, before the award of

the contract, complete specifications and drawings covering all parts of the machine.

67. After the award of the contract, foundation drawings in duplicate, giving all dimensions and details, must be submitted and approved before this work is started.

Alternate Proposal.

68. Bidders are requested to submit an alternate proposal to cover the installation, complete in every detail, of turbines of a different type from those specified, requirements as to construction details, fittings, lubrication, foundation, etc., to comply, as far as applicable, with those above specified.

RECIPROCATING ENGINES.

Requirements.

69. The intent of this specification is to provide for the engines to be delivered and erected complete in every detail ready for service in the power house where indicated on drawing No. P. P. 403. Engines to be of the latest and most approved pattern, having extra-heavy frames and fly wheels and especially adapted for direct connection to generators.

Number and Type.

70. It is contemplated to install three engines, each direct-connected to a generator. The engines are to be of the latest design, of simple automatic, high-speed, horizontal type, arranged to run at a steam pressure of 100 pounds per square inch and a back pressure of approximately 2 pounds per square inch, or to exhaust into the atmosphere.

Ratings.

71. Two of the engines are to be connected to 150 K. W. generators, to have normal rating of 225 brake horsepower when running at from 200 to 225 revolutions per minute with initial steam pressure of 100 pounds per square inch and exhausting into the atmosphere, and the third engine is to be connected to a 75 K. W. generator and is to have a normal rating of 113 brake horsepower when running at from 250 to 275 revolutions per minute with 100 pounds initial steam pressure and atmospheric exhaust.

72. Engines must be capable of developing the brake horsepower as given above and must further be capable of developing continuously a maximum horsepower of 30 per cent above normal rating without injurious effects.

Steam Consumption.

73. Bidders must state in their proposal the guaranteed steam consumption for the two sizes of engines, based on pounds of steam

per indicated horsepower per hour for $1\frac{1}{4}$ load, full load, $\frac{3}{4}$ load, $\frac{1}{2}$ load, and $\frac{1}{4}$ load.

Tests.

74. Shop tests of the three engines are to be made for determining steam consumption at the different loads, speed regulation, etc., by the mechanical engineer.

75. The contractor must notify the mechanical engineer when the engines are ready for test and shall furnish all apparatus necessary for the tests and pay all expenses incident thereto.

76. The shop tests may be omitted, if desired by the mechanical engineer, and such tests of the engines as may be considered advisable by the mechanical engineer made after their erection in the building.

Regulation.

77. The speed regulation of the engines must be such that under no conditions will the engines race, or under any change in load from the maximum specified to no load will there be a variation of speed of over 2 per cent above the normal.

Construction Details.

78. All parts of the engines shall be of heavy pattern and design, and constructed of materials best adapted for the various parts and in accordance with the most modern practice.

79. All castings to be of best quality cast iron, free from sand or blow holes, perfectly true to dimensions, having smooth, even surfaces.

80. The frames shall be extra heavy, having a substantial base, securely bolted to foundations. Fly wheels to be of proper diameter and width, the sides and face of rims being finished and polished.

81. The bearings to contain ample bearing surface and to be babbitted with best quality Babbitt metal, accurately fitted to shaft.

82. The valve mechanism to be of simple construction, easily adjustable, the valve being well balanced, preferably of piston type, and fitted accurately in place.

83. The engine governor is to be of the fly-wheel type, of the improved form of Rites governor or equal thereto.

84. The engine glands are to be provided with suitable approved metallic packing.

85. The engine shafts are to be extended as the armature shafts of generators and provided with outboard bearings.

Fittings.

86. Each engine is to be provided with the following fittings, all to be of first-class and approved make:

87. An extra-heavy throttle valve suitable for 250 pounds pressure, of design best suited to engine furnished, valve to be tapped for drip connection.

88. A 2-inch-diameter brass, nickel-plated, water relief valve at each end of cylinder.

89. A vertical type, flanged, heavy-pattern, steam separator with drip connection and water gauge to be placed just above automatic stop valve.

90. A balanced safety stop valve, operated independently of fly-wheel governor, arranged to close automatically at a predetermined maximum speed.

91. Cylinder drips and all necessary drains, with controlling valves, pipe connections to drip main in exhaust-pipe trench. All drip piping with valves to be finished brass, nickel-plated.

92. The cylinder to be insulated with not less than 2-inch-thick asbestos fire felt, or equal, and lagged with planished steel or other lagging that is standard with the manufacturer and acceptable to the mechanical engineer.

93. One full set of single-ended drop-forged steel wrenches to fit all the various nuts, with metal rack, to be secured in place where directed.

94. An indicating equipment complete, consisting of two latest approved type, of best quality, steam-engine indicators supplied with five springs, an approved reducing motion, 50 pencil points, 500 metallic cards, indicator tools, 10 yards indicator cord, one No. 3 style Amsler's polar planimeter, and one direct-reading triple-scale portable tachometer of approved make.

Lubrication.

95. Each engine is to be provided with a mechanically operated sight-feed lubricator of first-class and improved make, of not less than ½ gallon capacity, and also an approved hand pump of the same capacity.

96. All necessary oil cups are to be provided, of adjustable sight-feed type, and cranks are to be equipped with center oiling gear.

97. One complete set of oil cans, with tray, is to be furnished.

98. All oiling appliances, pipes, valves, etc., to be finished brass, nickel-plated.

99. Each engine is to be equipped with all necessary oil guards to prevent the throwing of oil on floor.

Foundations.

100. The engines and generators are to be securely bolted to concrete foundations extending to just below the floor line, three courses of brick being provided on top of concrete.

101. The foundations are to be installed by this contractor and must conform as to materials with requirements hereinafter specified.

Specifications and Drawings.

102. Bidders must state in their proposals the make of engines upon which their proposal is based and must submit, before the award of the contract, detailed complete specifications and drawings covering all parts of the machines.

103. After the award of the contract, foundation drawings giving all dimensions and details must be submitted before this work is started.

Alternate Proposal.

104. Bidders are requested to submit an alternate proposal to cover the installation complete in every detail of tandem compound or vertical cross-compound engines.

105. Requirements as to regulation, construction details, fittings, lubrication, foundations, etc., to conform as far as they are applicable with those of simple engines.

SECTION IV.—BOILER EQUIPMENT.

Type of Boilers.

106. Four boilers to be of horizontal-return tubular type, with overhanging fronts, constructed as shown by details on drawing No. P. P. 409, are to be furnished, located in one battery, as indicated on drawing No. P. P. 402. Boilers to be 72 inches inside diameter, 19 feet 7½ inches in length, and to contain 96 3½-inch-diameter tubes, 18 feet long.

Steel.

107. Shells and heads of boilers to be constructed of best quality open-hearth steel, free from all flaws and other defects. The variation of sheets must not be more than 0.015 inch less than specified. The three sheets of the shell are to be ½ inch thick and the heads $\frac{9}{16}$-inch-thick material.

Inspection and Tests of Materials.

108. Inspection and tests must be made of the steel for the boilers, and the contractor is required to notify the mechanical engineer when the plates are rolled and ready for inspection and tests. The surface inspection of the plates will be made at the mill and the passed plates and their coupons will be stamped by the inspector, which stamp, as well as the mill serial stamp, must be placed on the plates so that they may be seen after the boilers have been assembled and installed. Each steel plate must have attached thereto test coupons not less than 2 inches nor more than 2¼ inches wide by 36 inches long. The stamp on coupon to be placed about 3 inches from end and the coupons to be sheared off and prepared in three specimens, as directed by the inspector, and forwarded to the mechanical engineer, Department of Agriculture, for tests.

109. One specimen of each coupon must show an ultimate tensile strength of not less than 55,000 pounds nor more than 65,000 pounds per square inch, and an elongation of not less than 25 per cent in a length of 8 inches.

110. The other two specimens of the same coupon must be capable of being bent double upon themselves, one cold and one after being heated to a cherry red and quenched in water at a temperature of 80 degrees F., without sign of fracture.

111. Borings taken from portions of the broken tensile-test pieces will be analyzed in the Department laboratory, and plates containing, as shown by tests, more than 0.45 per cent magnesia, 0.04 per

cent phosphorus, 0.04 per cent sulphur, or 0.03 per cent silica will be rejected.

112. No plate must be used in the construction of any part of the boilers until it has satisfactorily passed the surface inspections and the foregoing tests, and the results of these tests accepted by the mechanical engineer and the contractor duly notified thereof.

Boiler Tubes.

113. The boiler tubes must not be less than 3½ inches external diameter, made of the best quality seamless-drawn steel, of uniform wire-gauge thickness, and free from all imperfections.

114. Tubes must be properly expanded into heads, beaded and all joints made absolutely tight without the use of packing.

115. Sections 1¼ inches long, of one tube, selected at random to represent the lot, must stand hammering down vertically parallel to axis without any transverse cracking or but very little longitudinal cracking. Tubes for this test to be selected by the inspector and forwarded by contractor to the mechanical engineer for testing.

Riveted Joints.

116. The ring seam joints are to be single-riveted, lap joints and the longitudinal seams triple-riveted, butt joints with top and bottom cover plates, as shown by details on drawing No. P. P. 409.

117. Rivets to be ⅞ inch diameter, of best quality mild steel, and of sufficient lengths to form proper heads. Pitch, lap, and spacing between rows of rivets to be as shown by details.

118. Holes for rivets must be drilled and not punched.

119. Sample rivets taken from the kegs by the inspector must stand being bent cold flat upon themselves, also after being heated and quenched without showing sign of fracture. Specimen rivets must not split, crack, or crumble when heated to a bright cherry red and drawn out to a thickness equal to one-fourth of the original diameter.

Bracing.

120. The boilers are to be braced as shown by the details, with channels, angle irons, and other stay rods of mild steel of sizes and dimensions given.

121. If the contractor desires to use crowfoot bracing in lieu of the other braces specified, consideration will be given by the mechanical engineer to detail working drawings submitted in duplicate. The crowfoot bracing must not, however, be used unless working drawings of same are approved by the mechanical engineer.

Manholes, etc.

122. An 11 by 15 inch manhole complete, of pressed steel, is to be provided for each boiler. Hand-holes with plates, gaskets, yokes,

etc., steam-outlet nozzles, and reenforcing flanges for all outlets, to be located where indicated and constructed of best quality cast steel.

Boiler Supports.

123. Each boiler is to be supported, as indicated by details on drawing No. P. P. 409, by four $1\frac{3}{8}$-inch-diameter steel hangers connecting with steel lugs riveted to the boiler. The hangers are to pass between two channels and to be provided with bearing plates and nuts above channels. The channels are to rest on plates on the brickwork of boiler setting, and each pair of channels are to be bolted together with four $\frac{3}{4}$-inch bolts, with separators.

Hydrostatic Boiler Test.

124. Each boiler, when assembled in place and before inclosure in brickwork, must be tested under a hydrostatic pressure of 250 pounds per square inch in the presence of the mechanical engineer and all defects shown by tests must be remedied.

125. All appliances for the test must be furnished by the contractor and he must also pay all expense of tests.

Settings.

126. The boilers are to be set in brickwork in accordance with details on drawing No. P. P. 409. Walls are to be constructed of best quality hard-burned brick, laid in Portland cement mortar, 2 to 1, to an elevation 1 foot above boiler-room floor line, and above that elevation in lime mortar, consisting of fresh wood-burned lime and clean sharp sand. All brickwork must be carefully laid and due allowance must be made in the bricking in of boilers for the expansion and contraction of same.

127. The exterior wall surfaces of setting to be faced with first-quality, selected, smooth, red brick, laid with close joints. All exposed inner wall surfaces, including bridge wall, side walls of furnaces, etc., as shown by the details, to be lined with first-quality fire brick, carefully laid in kaolin or best quality fire clay. Openings for firing and ash-pit doors are to be lined with fire brick, fire-brick arches being placed above openings.

128. All brickwork to be laid with headers every fifth course.

129. Back of bridge wall a flooring of common brick laid in lime mortar is to be placed, and the blow-off connection is to be protected by a fire-brick sleeve, as indicated.

130. The bridge wall is to be constructed, as shown, to form a duct for air supply to furnaces, the top being supported on angle and T-bars, and plate lintels are to be provided at openings into ash pits, as indicated.

131. An 18 by 24 inch, heavy-pattern, cast-iron clean-out door and frame is to be provided in the rear of each boiler as indicated.

Ash Pits and Firing Floor.

132. The ash pits and firing floor, to 8 feet in front of boilers, are to be paved with best quality vitrified brick, set on edge in cement mortar upon a concrete base.

Boiler Fronts.

133. The boilers are to have ornamental cast-iron fronts of approved design, especially suited for the furnaces to be used, having raised-pattern flue and fire doors, swinging right and left. Every part of the fronts must be a sound, true casting, out of wind, perfectly smooth, and free from flaws. Each front is to have cast thereon the letters U. S. D. A. as shown by the details, the letters being of large size, raised pattern. Detail working drawings of fronts must be submitted in duplicate and approved, before the fronts are constructed. The fronts must be fitted and put together previous to delivery at the building and be free from rust or thick paint.

Tie-rods and Wall Braces.

134. Boiler fronts are to be securely held to brickwork of setting by wrought-iron or steel tie-rods and the side walls of setting to be secured by cross tie-rods. Rods to be of not less than 1 inch diameter and to be provided with heavy cast or wrought iron braces, extending from top to bottom of setting. Braces at fronts of boilers to be executed in the form of pilasters.

Ladder.

135. A wrought-iron ladder, 16 inches wide, constructed with $\frac{3}{4}$-inch-diameter rungs and sides of $\frac{1}{2}$ by 2 inch bar iron, is to be provided and located as shown by the drawings at side of boiler setting, to extend to top of setting, as indicated.

Covering.

136. The rear and top of boilers above brickwork are to be covered with 2-inch-thick asbestos fire-felt lagging or material of equal quality, securely fastened in place with wire netting and fitting neatly around nozzles, manholes, etc., and finished with a smooth even surface of asbestos cement, not less than $\frac{3}{4}$ inch thick.

Alternate Boiler Proposals.

137. Bidders must state on their proposal sheets the amount to be added to or deducted from their total proposal, for the installation of internally fired boilers with corrugated furnaces, complete in every detail, in lieu of the horizontal return tubular boilers specified, and also to state the amount to be added to or deducted from their proposal for which they will install complete boilers of first-class water-tube type.

138. Proposals for these alternate types of boilers must include settings, forced-draft connections, etc., to make the installation strictly first-class, and to comply with the most modern practice in every respect, and detailed specifications covering the type of boiler considered and all appliances appertaining thereto must be submitted with the proposals. The specifications here called for must also state the guaranteed evaporation per pound of combustible from and at 212° F., which guarantee must be fulfilled by actual tests made by the contractor after installation, provided the alternate boiler proposal is accepted.

Smoke Breeching.

139. Smoke-breeching connections to each boiler and to stack to be of sizes and run as indicated on the plans, constructed of ¼-inch-thick boiler iron, riveted to 2 by 2 inch angle irons with ½-inch-diameter rivets, spaced 2 inches on centers. The breeching is to be supported by substantial wrought-iron hangers, secured to roof beams or by wrought-iron frames, secured to walls of boiler setting.

140. Cast-iron clean-out doors and frames are to be provided, as indicated in breeching, doors to be fitted absolutely tight and provided with the necessary hasps and catches. Breeching connection is to be extended to the inside edge of stack wall through arch opening provided, and an air-tight joint is to be made around breeching at outside face of stack wall by a 2½-inch angle-iron frame riveted to breeching and secured to stack wall with expansion bolts. Provision must be made for closing the opening above breeching formed by the arch and a suitable gasket provided between angle-iron frame and brickwork. The breeching is to be covered with 2-inch-thick asbestos fire-felt lagging, secured with wire cloth and finished with ¾-inch-thick asbestos cement as herein specified for boiler covering.

Dampers.

141. The smoke connection from each boiler is to be provided with an easy-moving damper of ⅛-inch-thick boiler iron, having suitable bearings and arranged with levers, rods, etc., so as to be operated by hand from the boiler-room floor, and also arranged so that same can be securely fastened in any desired position. A damper of ⅛-inch-thick boiler iron is also to be provided in the main breeching near connection to stack. This latter damper is to be arranged in an approved manner, to be operated by the damper regulator hereinafter specified.

142. At the air-supply inlet in the ash pit of each boiler a tight-fitting swinging damper of ⅜-inch-thick cast iron is to be securely fastened in place, and provided with operating levers and rods so that damper may be operated and secured in any desired position

from in front of boiler, the damper rod being extended through the boiler front close to the side of ash pit.

Furnaces.

143. Each boiler is to be provided with a first-class and approved make of shaking or rocking grate, each grate having not less than 39 square feet of surface and provided with all necessary appliances for operating same.

144. Bidders are required to state in their proposal an amount to be added to their total bid if the shaking grates above specified are omitted and each boiler is equipped with an automatically operated under-feed stoker of approved make and design, suitable for burning bituminous coal and of proper capacity for 150-horsepower boilers, operating mechanism, hoppers, retorts, dead plates with their supports, piping, etc., being furnished complete. In the event of this alternate proposal being accepted, the operating mechanism of stokers is to be located at the end of the battery of boilers and piping connections are to be installed, as directed by the mechanical engineer; the controlling apparatus is to be operated by a silent chain drive from the draft-fan shaft, both sprockets being included with the stoker installation. All necessary steam and exhaust connections are to be made by the contractor, the exhaust connection being run and connected with the exhaust from feed-water pumps, and steam connection is to be provided with approved sight-feed lubricator. Working drawings in duplicate of stokers, showing the arrangement of piping, etc., must be submitted for approval.

145. Bidders are also requested to state in their proposal an amount to be added to or deducted from their total proposal for installing, complete in every detail, mechanical stokers of a different type from those above specified, giving make of stoker upon which figure is based, together with complete description of same.

Draft Fan.

146. For the forced-draft apparatus a steel-plate, horizontal, bottom-discharge fan, driven by an electric motor at approximately 540 revolutions per minute through a silent chain drive of first-class and approved manufacture, is to be provided. The fan is to be placed on a concrete foundation as shown and the motor supported on a brick pier with concrete footing. Wheel of fan to be 42 inches diameter and housing to have largest diameter, approximately 70 inches. Wheel must be well balanced, mounted on and well secured to shaft, having two bearings with self-lubricating journals. Sprocket wheels must be overhung, but kept as close to housing as possible. The end of shaft opposite to end of motor drive must be extended through bearing and keyed for a sprocket wheel suitable

for driving the mechanical stokers. Fan housing to be constructed of heavy steel plates, well stiffened with angle and tee braces, the braces being secured to base angles, which are to be firmly bolted to the concrete foundation. Fan motor to be as specified under electrical section of this specification. The fan outlet, approximately 24 by 24 inches, is to be connected, as indicated, by a $\frac{1}{8}$-inch-thick boiler-iron duct, framed with $1\frac{1}{4}$-inch angles to the end of the duct formed in the bridge wall, this opening being approximately 30 by 34 inches. A tight-fitting joint is to be made between duct and brickwork, a rubber gasket being placed in the joint. Bidders are requested to state in their proposal the amount to be deducted from their total proposals if the entire forced-draft equipment, including fan, motor, motor-controlling devices, tablet, etc., is omitted.

Boiler Trimmings.

147. Each boiler to be provided with the following trimmings, all of first-class and approved make:

Two 4-inch pop safety valves.

A special Siamese fitting to be attached to the 4-inch outlet nozzle on boiler for the two safety valves.

One steam-pressure gauge for high pressure, with noncorrosive movement and 12-inch-diameter dial, graduated to 200 pounds, having polished-brass case. The connection to steam gauge to have siphon and draincock in proper position.

One extra-heavy, combination, polished-brass gauge column with sediment chamber, having water gauge with safety controlling valves and three polished-brass gauge cocks of approved and first-class construction, with lifting handles and operating brass rods, and also provided with an approved high and low water alarm. Connections of $1\frac{1}{4}$-inch-diameter brass pipe to be made to boiler and to bottom of sediment chamber. The drip pipe with drip valve at sediment chamber is to be run to discharge into the ash pit.

148. On boiler-feed connection:

One $1\frac{1}{2}$-inch-diameter brass globe valve.

One $1\frac{1}{2}$-inch-diameter brass check valve.

149. A 2-inch brass globe valve is to be provided on each of the vertical-feed connections for supplying two boilers, and a 1-inch-diameter brass globe valve with hose nipple on the extension of the vertical feed pipes.

150. On blow-off connections: One 2-inch-diameter, extra-heavy, angle, blow-off valve.

151. At the steam outlet at end of battery of boilers a 2-inch globe valve with hose connection is to be provided, and a tube-blowing nozzle with sufficient length of flexible wire-wound hose to blow the tubes in any boiler is to be provided. A globe valve is to be placed on hose close to nozzle.

152. One approved make of tube cleaner is also to be provided.

Injector.

153. A first-class, approved make, double-tube injector of 300-horsepower capacity to be furnished and properly placed in boiler room where shown, supplied with all necessary pipe connections and finished-brass controlling valves.

Damper Regulator.

154. One damper regulator of first-class and approved make is to be furnished and connected to the damper in the main smoke breeching near stack, the regulator to be of such positive action that a small variation of pressure will operate the damper.

155. The contractor must also furnish all necessary shafting, bearings, hangers, pulleys, and chains to connect regulator with damper in duct and to make all required connections to regulator, which is to be located on north wall of boiler room where directed and covered by an inclosure constructed of oak, cabinet finish, with glass door.

Firing Tools.

156. The following firing tools to be furnished:

One steel-wire brush with sectional handles for cleaning flues.

Two slice bars,
Two wrought-iron pokers,
Two wrought-iron hoes,
} All made of wrought-iron pipe with forged-steel ends.

Four scoop shovels, No. 5.

Two wrought-iron scrapers in different lengths with jointed rods for cleaning smoke breeching.

Two 2-wheel coal barrows of 500 pounds capacity each.

SECTION V.—PUMPS, HEATERS, TANKS, ETC.

Boiler-feed Pumps.

157. Two approved-make 7½ by 5 by 6 inch duplex steam pumps of ram pattern with outside packed plungers, suitable for a pressure of 125 pounds, are to be furnished and placed where indicated in pump and heater room. Pumps to have hot-water valves, brass water piston and piston rods, operating in brass-lined cylinders and stuffing boxes, and fitted with the necessary drip pipes, valves, cocks, etc. Each pump is also to be provided with one 1 pint capacity. brass, sight-feed lubricator of first-class and approved make.

158. Pumps to be placed on brick foundations, having cast-iron caps or drip pans with 2-inch projections on edges to form pan and 2-inch projection to form cap over brick pier, and with necessary holes for anchor bolts with raised bosses at each hole.

159. Steam, exhaust, suction, and discharge connections are to be made as shown on the drawings, and drains and drips are to be connected to the main drip line as indicated.

160. Bidders are required to state on the proposal sheet the amount to be added to or deducted from their total proposal for the furnishing of two vertical-type pumps of size, construction, etc., of the pumps above specified, in lieu of the horizontal pumps.

Circulating Pumps of Heating System.

161. Two single-stage 8-inch turbine pumps of approved make, each having a capacity of 1,200 gallons per minute against a head of approximately 60 feet, are to be furnished and located, on brick piers, where indicated on plans and connected to the circulating mains of the heating system. Each pump is to be driven by an electric motor, mounted on the same base, through the medium of a flexible coupling of heavy pattern and approved make, to allow an independent alignment of pump and motor. Motor to be as specified under electrical section of this specification.

Cold-water Pumps.

162. Two single or double stage centrifugal pumps of approved make, each having a capacity of 100 gallons per minute, against an approximate head of 150 feet, are to be furnished, located where shown, and connected to the cold-water supply system. These pumps are to be driven by motors mounted on the same base through a flexible coupling.

Catch-basin Pump.

163. One vertical-type single-stage centrifugal pump of approved make, of 50 gallons per minute capacity against a head of approximately 12 feet, is to be furnished and properly supported at bottom of catch-basin. The shaft is to be extended through cover of catch-basin and is to have mounted thereon a vertical-type motor supported in an approved manner. Pump discharge is to be connected to piping of drainage system as indicated.

Air Compressors.

164. Two horizontal, heavy-pattern, single-stage air compressors, of first-class and approved make, each having a displacement of approximately 140 cubic feet of free air per minute while maintaining a pressure of 60 pounds per square inch in storage tank, are to be furnished and located in engine room as shown on plans. Compressor cylinders are to be not less than 10 inches diameter and stroke to be approximately 10 inches. Compressors are to be driven by electric motors by means of approved silent chain drives, with suitable guards, the motors being mounted on same base with compressors. Each compressor to be provided with an extra-heavy fly wheel. Air cylinders to be water-jacketed on sides and head and valves and seats are to be self-contained and easily removable, and a full set of sight-drip oil cups and sight-feed lubricator for the air cylinder and necessary tools are to be provided. All connections to air, water, and drain pipes are to be made by this contractor.

Vacuum Pump.

165. One horizontal dry vacuum pump, having a displacement of 340 cubic feet of free air per minute, with cylinder not less than 16 inches diameter and stroke approximately 10 inches, is to be furnished and placed in engine room as indicated. Vacuum pump to correspond in make and type and to be connected and equipped as specified for air compressor.

166. Bidders are required to state in their proposals the amount for which they will install complete a duplicate vacuum pump to the one specified, located adjacent to the other pump, having all necessary connections to air, water, and drain pipes, foundations, etc.

Vacuum Receiver.

167. A vacuum receiver tank, approximately 30 inches diameter by 72 inches high, constructed of best quality flange steel with $\frac{1}{4}$-inch shell and $\frac{5}{8}$-inch heads, riveted with $\frac{9}{16}$-inch rivets, 2 inches on centers, is to be provided and located in engine room where indicated and provided with the connections shown. Tank to be also tapped for pressure-gauge connection.

Air Receiver and After-cooler.

168. A first-class, approved-make, heavy-pattern air receiver and after-cooler, approximately 24 inches diameter by 8 feet high, consisting of flange-steel shell and cast-iron or steel heads and containing brass tubes, is to be furnished and installed in engine room where indicated, supported on a suitable cast-iron cradle or standard. Receiver to have all outlets reenforced and to be provided with valved water and drain connections, a 2-inch-diameter pop safety valve of approved make, and outlet for pressure-gauge connection. Receiver must be constructed to stand a hydrostatic-pressure test of 150 pounds per square inch.

Muffler Tank and Oil Extractor.

169. Where indicated on plan, an exhaust muffler tank and oil extractor of standard dimensions for 16-inch exhaust connections of Keiley make or equal is to be installed. The tank must be strongly constructed with reenforced outlets, baffle plates, etc., and provided with a valved steam connection for cleaning and valved connection to drain piping.

Feed-water Heater.

170. A feed-water heater of the closed type, of 500-horsepower guaranteed capacity, is to be furnished and placed in engine room where indicated. Heater to be of first-class and approved construction, having 16-inch exhaust-pipe connections and $2\frac{1}{2}$-inch water connections to copper coil, and to be supported on iron legs or standards.

Hot-water Heater.

171. A water heater, of the closed type, with copper coil of sufficient capacity to heat 40 gallons of water per minute from 40° F. to 160° F. with exhaust steam, is to be furnished and installed in pump and heater room where indicated. Heater to be supported on iron standard or legs and to be connected to piping as indicated.

Drawings, etc.

172. Bidders must state on the proposal sheets all makes and other data required of the pumps, tanks, heaters, etc., above specified, which they propose to furnish, and, after the award of the contract, detailed working drawings and specifications of each must be submitted in duplicate for the approval of the mechanical engineer.

Water Heaters for Heating System.

173. Four water heaters, constructed as shown by details on drawing No. P. P. 408, are to be furnished and placed in pump and

heater room, where indicated. Heaters to be constructed of $\frac{3}{8}$-inch-thick flange-steel shells and to contain 291 2-inch outside diameter seamless-drawn steel tubes, 6 feet long expanded into $\frac{7}{16}$-inch heads. Flanged heads, with reenforcing ribs, angles, and supporting lugs, are to be of best quality cast steel of dimensions given. The heads are to be provided with 8-inch standard flange outlets, to be bolted to the angle irons, and the angle irons and lugs are to be riveted to the shell, as indicated. Supporting lugs are to be bolted to 4-inch standard flanges with 4-inch pipe supports extending to floor, with flanges resting on, and secured with expansion bolts to, concrete piers. Steam and return pipe nozzles of standard dimensions are to be securely riveted to shells where indicated.

Receiving Tank.

174. A receiving tank, 3 feet 6 inches diameter by 5 feet 6 inches long, constructed as shown by details on drawing No. P. P. 408, of flange steel $\frac{1}{4}$ inch thick in shell and $\frac{5}{16}$ inch thick in heads, is to be furnished and located adjacent to boiler-feed pumps. Tank to be provided with an approved tight-fitting 11 by 15 inch manhole complete, water glass with shut-off and drain cocks and with reenforcing flanges of standard dimensions at all outlets. Connections to receiving tank are to be arranged as shown on the drawings.

Cold-water Tank.

175. A pressure tank for cold water, 48 inches in diameter by 8 feet high, is to be furnished and located on brick pier in pump and heater room where shown, constructed as indicated by details on drawing No. P. P. 408, of flange steel, having $\frac{1}{4}$-inch shell and $\frac{5}{16}$-inch heads. Tank to be furnished with a standard 11 by 15 inch manhole complete, water glass with shut-off and drain cocks, and reenforcing flanges for all connections, which are to be located as shown on the drawings.

Hot-water Tank.

176. A storage tank for hot water, 36 inches diameter by 6 feet high, is to be located where indicated on plans, and constructed as shown by details on drawing No. P. P. 408, of flange steel with $\frac{1}{4}$-inch shell and $\frac{5}{16}$-inch heads. Connections to tank with reenforcing flanges are to be made as indicated and tank is to be provided with water glass with shut-off and drain cocks and 11 by 15 inch standard manhole complete, and a thermostatic regulator for controlling the steam supply to the hot-water heater.

Blow-off Tank.

177. A blow-off tank, as shown by details on drawing No. P. P. 408, is to be furnished. Tank is to be 48 inches diameter by 12 feet

long, constructed of best quality flange steel ¼ inch thick in shell and $\frac{5}{16}$ inch in heads. Tank to be supported, where shown on plans at the rear of boilers, on heavy-pattern cast-iron cradles set on brick piers. An 11 by 15 inch standard manhole and a 24-inch water glass with shut-off and drain cocks and reenforcing flanges at all connections, which are to be made as indicated, are to be provided for tank.

Expansion Tank.

178. An expansion tank, 24 inches diameter by 6 feet long, is to be furnished and connected to return main of heating system where indicated in pump and heater room, tank to be constructed, as shown by details on drawing No. P. P. 408, of flange steel ¼ inch thick in shell and $\frac{5}{16}$ inch thick in heads, and to be supported on bar and angle iron frames and rods as indicated, the frames being securely fastened to wall with expansion bolts. Tank to be provided with a water glass with shut-off and drain cocks and reenforcing flanges at all connections.

Hydrostatic Test of Tanks.

179. The receiving tank, cold and hot water tanks, the vacuum, compressed-air, expansion, and blow-off tanks are to be subjected to a hydrostatic pressure test of 150 pounds per square inch, after installation, in the presence of the mechanical engineer. All openings must be capped and plugged, and all appliances necessary for the test must be furnished by the contractor, who must also bear any expenses incident to the tests.

Catch-basin.

180. A cast-iron catch-basin, 36 inches diameter by 54 inches high, inside dimensions, constructed as indicated on drawing No. P. P. 408, is to be furnished and set at end of pump and heater room, the basin being placed so as to extend below the floor as indicated. Basin to have flanged cover, bolted in place, openings for drain connections as shown, a 12-inch-diameter cover plate in recessed opening and openings through cover for vapor pipe, pump discharge, pump shaft, and motor-controlling mechanism. Castings to be smooth and of even thickness, of best quality gray iron, without flaws and other imperfections.

Traps.

181. Four separating steam traps of 75 series, Bundy type, or equal, with 1½-inch water and 1¼-inch steam connections, for steam at approximately 10 pounds pressure, are to be furnished by contractor and connected to the drip lines. Two of the traps are to be located in tunnel where shown, for raising the condensation in the

steam drip line at the change in elevation of the tunnel, the other two being located in pump and heater room for discharging the condensation of the steam drip lines overhead into the low-pressure drip main connecting with the receiving tank.

182. One separating steam trap of 75 series, Bundy type, or equal, with 1¼-inch water connections and 1-inch steam connection, is to be installed for discharging the condensation of the hot-water heater into the overhead low-pressure drip line, as indicated.

183. Two extra-heavy steam traps of Style C, Keiley, or equal, make, designed for 125 pounds steam pressure with 1½-inch-diameter connections, are to be furnished and located where indicated in pump and heater room, and connected as shown for discharging the high-pressure drips and the drips from separators into receiving tank. All traps are to be provided with full-size valved by-pass connections as shown, with swinging check valves on discharge connections.

Foundations for Appliances.

184. The boiler-feed pumps, cold-water pumps, circulating pumps, air compressors, vacuum pump, and cold and hot water tanks are to be placed on brick piers, the piers for boiler-feed pumps being approximately 18 inches high and other piers of the heights indicated on drawings. Piers for all appliances except air compressors and vacuum pump are to be built on the concrete floor of the pump and heater room, unless otherwise indicated. Each air-compressor and vacuum-pump pier is to rest on a concrete base, to be installed by this contractor, as indicated on the drawings. Concrete footings are also to be provided for the supports of the water heaters of heating system, as indicated.

Coverings for Appliances.

185. The receiving and muffler tanks, water heaters of heating apparatus, feed-water heater, hot-water supply heater and tank, and expansion tank are to be insulated with 1-inch-thick asbestos fire felt or material of equal quality, firmly secured in place with wire cloth and finished with ¾-inch-thick covering of best quality asbestos or magnesia cement troweled smooth and even and covered with heavy canvas sewed on.

SECTION VI.—DISTILLED-WATER APPARATUS.

Requirements.

186. The intent of this specification is to cover complete in every detail the installation of a distilling apparatus, consisting of evaporators, condensers, storage tanks, piping, etc., all parts conforming with the most modern practice.

187. The apparatus to be in duplicate units, so connected that they can be operated together or each separately.

188. The apparatus is to be installed, with the exception of the storage tanks, in the room designated for distilled-water apparatus on the engine-room plan, which room is approximately 12 feet wide by 15 feet 6 inches long, and having 12 feet clear height.

189. The apparatus must furnish pure water as shown by actual tests, without the use of coke or charcoal or without treating the water in any manner after being distilled.

Capacity.

190. The apparatus to have a capacity to furnish 130 gallons of distilled water per hour, the condensing water being used in the evaporator and steam of evaporator being furnished at 40 pounds pressure per square inch.

Evaporators.

191. Two evaporators, each of 65 gallons per hour capacity, consisting of a cylindrical reservoir of best grade flange steel, not less than $\frac{5}{16}$ inch thick in shell and $\frac{3}{8}$ inch in heads, containing a copper coil of seamless-drawn copper tube, heavily coated with pure block tin and containing the necessary number of square feet of surface, are to be furnished and supported on suitable iron standards or frames. The coil must be tested to withstand not less than 150 pounds hydrostatic pressure per square inch. The connections between shell and head or heads of evaporators are to be made with flanged joints, having gaskets of best quality steam packing, and connections to the coils are to be made with unions so that evaporators and coils may be easily taken apart. The openings in evaporator casings for pipe connections to be reenforced with suitable flanges. A valved drain connection is to be provided for each evaporator.

Condensers.

192. The condensers, of each unit, must have ample surface to condense 65 gallons of water per hour with condensing water at

initial temperature of approximately 60° F. and must be constructed of copper, riveted with copper rivets. All condensing surfaces must be heavily coated with pure block tin. Condensers to be provided with an adjustable opening to atmosphere to allow the escape of volatile gases.

193. The condensers are to be suitably arranged relative to the location of the evaporators, preferably being placed immediately over, and supported from, the evaporators.

194. Each individual condenser, or the entire number of condensers of each unit, is to be inclosed in a cylindrical casing for containing the condensing water, constructed of flange steel of not less than $\frac{1}{4}$ inch in thickness, having riveted longitudinal joints and flanged ring joints. The condensers are to be secured in place with flanged connections so that they may be readily removed.

195. The outside surfaces of condenser casings are to be suitably finished, being painted or bronzed in a first-class manner, as may be approved.

Tanks.

196. Two storage tanks of dimensions given, and constructed as shown by details on drawing No. P. P. 408, are to be furnished and installed in pump and heater room, having connections, etc., as shown by plans, the tanks being supported on brick piers as indicated. The tanks to be lined with best quality pure block tin, not less than $\frac{1}{16}$ inch in thickness, the lining being extended to form a gasket for the flanged joints of the pipe connections and also of the ring joints.

197. Special care must be taken in the construction of these tanks that the lining be of uniform thickness and continuous, with no joints that will be acted upon by the distilled water.

Piping.

198. All connections for steam, distilled water, condensing water, steam drips, drains, etc., are to be made complete.

199. The piping for tanks to be installed as indicated on the plans and details, two water gauges with stop and drain cocks being provided for each tank.

200. Outlets in pump and heater room are provided for cold condensing water, steam, steam drip, and drain connections. From these outlets, piping of suitable sizes is to be run as approved for the various connections to evaporators and condensers, the connections being provided with all necessary controlling valves for each unit.

201. The overflow from the condensers is to be arranged to feed into the evaporators, the piping being installed to maintain the required water line above the evaporator coils, the surplus condensing water discharging into the drain.

202. Two Keiley or equal steam traps, having $1\frac{1}{4}$-inch-diameter connections, are to be furnished and connected to receive the condensation from the evaporator coils, the piping being arranged and valved so that one trap may be used for each unit or for both units. Each trap is to be provided with a full-sized valved by-pass, outside of trap. Trap-discharge connections are to be connected to the low-pressure steam drip line, where indicated, in pump and heater room.

203. Piping for steam, cold water, distilled water, etc., with valves, are to comply with the requirements herein specified for each particular purpose. Pipes to be painted, covered, etc., as herein specified.

Specifications and Drawings.

204. Contractor must submit, for approval, detailed specification and drawings covering every part of the distilling apparatus, including complete working drawings of all appliances and arrangements of piping, valves, etc., for the approval of the mechanical engineer. No work will be started until the required drawings have been definitely approved.

SECTION VII.—PIPES, VALVES, ETC.

High-pressure Steam Piping.

205. The high-pressure steam piping to consist of a 10-inch circuit main, including the boiler header, overhead main in engine room, and the main at ceiling in pump and heater room and branches therefrom, as boiler connections, engine supplies, supply to boiler-feed pumps, and connections to pressure-reducing valves, hot-water heater, and muffler tank, where indicated in pump and heater room. Bent pipe without kinks or flat surfaces is to be installed on the high-pressure steam loop and also on boiler and engine connections as indicated.

Exhaust Piping.

206. The engine-exhaust piping is to be run in trenches below the engine-room floor to pump and heater room, the 16-inch-diameter main connecting to the muffler tank and oil extractor. Bent pipe connections to be made to engine exhausts, as indicated. A 16-inch main is also to be run, as indicated, to the location for the outboard exhaust with back-pressure valve above heater, extending through roof and terminating in an exhaust head.

207. The exhaust from the boiler-feed pump is to be connected to the main exhaust, as indicated.

208. From the muffler tank, exhaust connections are to be made to the water heaters of heating system and hot-water supply heater, as shown on the drawings, and to the radiators in rooms on engine-room floor, the ends of the radiator supply piping being connected to the low-pressure drip main.

Blow-off Piping.

209. The blow-off connection from each boiler is to be connected to the blow-off header at the rear of boilers, connecting to blow-off tank in northwest corner of boiler room. The connections at tank, including tank by-pass, drain, vapor pipe, overflow arrangement, and discharge connections to same, are to be installed as shown by the plans. The vapor pipe is to be extended through roof as indicated.

Boiler-feed Piping.

210. The suction of the boiler-feed pumps is to be run from the receiving tank with supplementary connections from the cold-water supply, as indicated.

211. Discharge piping from the pumps is to be run as shown through feed-water heater, or heater by-pass, to the feed main running across top of boilers, suspended on pipe rolls, on brick piers of setting, adjacent to front channel-iron boiler supports.

212. Branches are to be run over from main and down between each pair of boilers with connections to each individual boiler as indicated.

213. The connection to each boiler is to be run through front head extending along boiler to near location of rear supporting lugs and then extended across boiler above tubes, having two outlets, one at each side of boiler.

214. Connection is to be made to the feed main from the injector, hereinbefore specified.

Cold-water Piping.

215. Contractor is to make a 6-inch-diameter connection to the 20-inch water main under the north sidewalk on B street SW., where indicated, the contractor paying the necessary expenses and charges for the connection and shut-off valve.

216. The 6-inch-diameter main is to be run along wall of boiler room and to be connected with the suction of the cold-water pumps, having branch connections to injector and for supply to engineer's sink.

217. The cold-water pumps are to discharge into the pressure tank, from which a 6-inch supply main is to be run near ceiling of pump and heater room, connecting with building supply main in tunnels and provided with the various branch pipes, run as indicated to the different appliances and apparatus.

Hot-water Piping.

218. Supply to the hot-water tank to consist of water from the air cooler and cylinder jackets, or from the cold-water main, as the case may be, the piping being arranged as indicated.

219. The hot-water main from tank to connect with the building supply piping in tunnels, having the branch for the toilet-room supply where indicated.

220. Circulating connections to be made between tank and heater as shown, and the hot-water circulating main from building to be connected to piping near bottom of tank.

Compressed-air Piping.

221. The suction for the air compressors to be taken from above the roof of the engine room and the discharge of compressors run as shown to the storage tank and cooler. From this tank the compressed-air main is to be connected with the building supply piping

and to have branch connections to the distilled-water, cold-water, hot-water, and expansion tanks, and a connection to the pneumatic valve of the hot-water heater.

222. Air filters, consisting of approximately 6-inch-long sections of pipe between two flanged joints, the sections of pipe being filled loosely with cotton held in place by fine-mesh wire screens, are to be provided on the main suction pipe of the air compressors and on the connections to each distilled-water tank. Filters to be located where directed, being easily accessible.

Vacuum Piping.

223. The suction pipe from the buildings is to be connected to the receiver tank, from which the pump suction is to be run as shown. The exhaust from the pump is to be carried above roof, as indicated.

224. In both the suction and exhaust connections of pump, plugged fittings are to be provided for future connections to an additional pump.

Medium-pressure Steam Piping.

225. Steam piping, beyond the reducing valves in pump and heater room, is to be run as indicated, providing an auxiliary supply at approximately 2 pounds pressure per square inch to water heaters of heating system, and steam at approximately 40 pounds pressure for connecting to buildings, to distilling apparatus, and to steam traps.

Drip and Drain Piping.

226. The low-pressure steam drip line from the buildings to discharge into the separating traps, as indicated, which are to discharge the condensation overhead into the low-pressure drip main connecting with the receiving tank. The condensation in the hot-water heater is also to be trapped into this main.

227. Drips from high-pressure steam mains and from engine separators, if same are provided, are to be run as indicated to the high-pressure traps, which discharge into the receiving tank, the separator drips being run in trench of exhaust piping, as shown.

228. The return from the four water heaters of the heating apparatus is to be run and connected to the receiving tank, as indicated.

229. Drain connections from the various appliances and apparatus are to be made to the two drain lines running near floor, one on either side of the pump and heater room, which mains are to discharge into the catch-basin.

230. An auxiliary discharge from this catch-basin is to be provided by a suction tee having suction, steam, and discharge connections as indicated.

231. Three extra-heavy, cast-iron, bell-trap cesspools with 4-inch outlets and hinged covers are to be provided and placed in floor of pump and heater room with drain discharging into catch-basin.

Gas Piping.

232. This contractor is to make a service connection to the street gas-supply main, paying all necessary charges for same, and is to bring a 4-inch-diameter main into the power house, where indicated, to be run to location shown for meter. From meter, the supply main is to be run down into pump and heater room and connected to supply piping of buildings.

Vacuum-cleaning Piping.

233. The two 3-inch-diameter mains from the buildings are to be connected into a 4-inch-diameter main at the end of tunnel and this main is to terminate at ceiling of pump and heater room for future connection to cleaning-system apparatus.

Distilled-water Piping.

234. The discharge connections from the distilled-water condensers, hereinafter specified, are to be connected to the two storage tanks as shown, these tanks having outlets connecting with the tunnel mains supplying the building.

Heating Mains.

235. The 8-inch-diameter return mains of the heating systems are to be connected into a 10-inch-diameter main in pump and heater room, which main is to be connected to the suction of the two circulating pumps. The pumps are to discharge into a 10-inch-diameter main, connecting, as indicated, with the four water heaters arranged as shown, so that any number of heaters may be used in series or all in parallel.

236. A 6-inch-diameter heater by-pass connection is to be provided as indicated. The outlets of the heaters are to be connected to the 10-inch-diameter flow main, which is to supply the two 8-inch-diameter mains.

Tunnel Piping.

237. The system of tunnel piping is shown on drawing No. P. P. 407 and consists of the following mains from power house to each building: Two 8-inch-diameter heating mains, one 4-inch-diameter steam, one 4-inch-diameter cold-water, one 3-inch-diameter hot-water one 3-inch-diameter gas, one 3-inch-diameter vacuum-cleaning, one $2\frac{1}{2}$-inch-diameter distilled-water, one 2-inch-diameter compressed-air, one 2-inch-diameter vacuum, one 2-inch-diameter hot-water circulating, and one $1\frac{1}{2}$-inch-diameter steam-drip main.

238. These pipes are to be run as shown by the details on pipe racks, the pipes being arranged in four rows, one above the other. At each building connections are to be made to piping in place, short nipples and unions being installed beyond the elbows on top of the risers, where pipes leave racks.

239. Anchors and expansion joints are to be provided and placed on piping in tunnels, as shown on the drawings and as hereinafter specified.

Pipe.

240. All high, medium, and low pressure steam piping, including exhaust-steam piping, all steam-drip, drain, blow-off, vapor, gas, and hot-water heating mains, unless otherwise specified, are to be best quality black, wrought-iron or mild-steel pipe of the sizes noted on the drawings and herein specified, straight, true, round, and of standard wire-gauge thickness. Pipe 1¼ inches diameter and smaller to be butt-welded and proved to 300 pounds per square inch hydrostatic pressure. Pipe 1½ inches diameter and larger to be lap-welded and proved to 500 pounds per square inch hydrostatic pressure.

241. All bent pipes, shown on the drawings and herein specified, are to be extra-heavy wrought-iron or mild-steel pipes.

242. All cold-water, hot-water, hot-water circulating, compressed-air, vacuum, and vacuum-cleaning piping, and also vapor pipes above roof, to be galvanized, and all distilled-water and boiler-feed piping from the discharge of the boiler-feed pumps to boilers, including connections to feed-water heater, to be galvanized tin-lined pipe, pipe to be of standard gauge thickness, of wrought iron or mild steel, and proved by hydrostatic pressure as above specified.

243. Boiler-feed piping inside of boilers to be 1½ inches in diameter, annealed, seamless-drawn brass tubing of standard wrought-iron pipe gauge thickness, pipes to be properly supported from braces and to be connected inside of front head to the tin-lined pipe.

244. The 4-inch-diameter drainpipe below floor in pump and heater room to be cast-iron hub and spigot pipe, having an average weight of 13 pounds per linear foot. The 6-inch water-service connection and the 4-inch gas-service connection to be cast-iron pressure pipe, as approved by the District regulations for such connections.

Fittings and Joints.

245. All fittings, except ground-joint unions and couplings, unless otherwise specified, to be manufactured of best quality gray cast iron, the castings to be of uniform thickness, entirely free from sand holes and to have fine smooth surfaces. Fittings on galvanized-iron pipe must be heavily galvanized and those on galvanized tin-lined pipe must be galvanized and tin-lined.

246. Special care must be taken with the installation of the tin-lined piping to make lining continuous through couplings and fittings, the ends of the pipes at couplings being cut off square and brought together at center of couplings and against shoulder in fittings.

247. Fittings for gas piping to be heavy-pattern malleable-iron screw-jointed fittings.

248. Fittings for brass piping to be finished-brass malleable-iron pattern.

249. Y branches with $\frac{1}{8}$ bends are to be provided on cast-iron drainage piping of weight to correspond with weight of pipe. Fittings on cast-iron pressure pipe to be long radius, and all joints in cast-iron piping to be made of best quality oakum and best quality and brand of soft pig lead, joints to be made in an approved manner.

250. Fittings for high-pressure steam, boiler-feed, and blow-off piping to be extra heavy and designed for a working pressure of 250 pounds per square inch. All other fittings to be of standard weight, designed for 150 pounds pressure per square inch.

251. Fittings on all high-pressure steam piping, 3 inches in diameter and over, and on exhaust piping 8 inches in diameter and over, to be flanged fittings. The fittings on the flow and return mains of heating system, and on the return connections from water heaters to receiving tanks, to be flanged fittings. All other fittings to be screw fittings with heavy beads and full-cut tapering threads.

252. All joints in piping $2\frac{1}{2}$ inches diameter and over, except at fittings and on tin-lined pipe, gas, compressed air, vacuum, and vacuum-cleaning piping, are to be made with flanged unions.

253. Fittings on pipe for vacuum-cleaning system must be recessed long-radius fittings, and at all changes in direction of the piping and on straight runs of piping in tunnels approximately 50 feet apart, Y branches must be installed with full-size clean-out outlets, fitted with brass-screw clean-out plugs.

254. Thickness and pattern of flanges, including number and size of bolts, to correspond with that specified for fittings on the particular kind of piping.

255. All threads on piping must be full and clean cut, and in screwing up the piping no other lubricant than best linseed oil and plumbago must be used, except on gas piping, where joints are to be put together with red lead or litharge.

256. At flanged joints in all cases the piping is to be screwed clear through the flanges, and the face of all flanges on fittings, valves, and piping for high-pressure steam must be finished with a rough surface.

257. All gaskets used must be of best quality sheet steam packing of approved make. Bolts to be of standard dimensions of best quality wrought iron with square heads and of suitable length to project entirely through the nuts.

Pipe Supports.

258. All pipes are to be securely supported in position by hangers in an approved and substantial manner.

259. The piping in tunnels is to be supported on pipe rolls, held in place on rods secured at one end by flanges against a bar-iron support and at the other end by a clamp around a pipe standard. These racks are to be placed where indicated on drawing No. P. P. 405, the details of racks to be as given on drawing No. P. P. 407.

260. In the pump and heater room, 4-inch 8½-pound I beams are to be installed where indicated, extending across the room, the upper flanges being placed against ceiling. From these beams all overhead piping is to be supported by heavy-pattern, wrought-iron, adjustable, expansion hangers, secured from beams with beam clamps. Where the beams are not suitably located for supporting piping, the hanger rods must be extended through the floor construction and provided with wrought or cast iron plates, washers, and nuts.

261. The high-pressure steam piping and all other overhead piping outside of pump and heater room is to be supported by hangers as above specified, secured to roof trusses or roof beams.

262. Pipes running along walls are to be supported on rolls with chairs resting on wrought-iron brackets, securely fastened to walls with heavy expansion bolts.

263. All pipes near floor and in trenches are to be supported on rolls with chairs resting on floor or bottom of trench.

264. Supports for all piping to be placed approximately 10 feet apart and to be so adjusted as to give proper grade to pipes.

Pipe Sleeves.

265. Where pipes pass through brick walls, wrought-iron pipe sleeves, two sizes larger than the pipes to pass through same, are to be provided and placed, the sleeves being in length equal to the thickness of the wall in each case.

Expansion Joints and Anchors.

266. Expansion joints are to be provided in the tunnels on the heating, steam, steam-drip, hot-water, and hot-water circulating mains, where indicated on drawing No. P. P. 405, there being four joints on each main.

267. Expansion joints to be of seamless-drawn corrugated copper tubing with interior and exterior rings, fitting loosely the corrugations and having a brass slip tube and cast-iron flanges. Joints must be of sufficient length to accommodate the expansion and contraction of the mains, the maximum temperature being approximately 200° F. for water and steam drip pipes and 290° F. for the medium-pressure steam pipes. Joints must be properly supported in place and be absolutely tight under working conditions.

268. At points midway between expansion joints and at ends of mains where indicated, the pipes in tunnels, which are to be furnished with expansion joints, are to be firmly anchored in place by round iron straps, threaded at ends and provided with nuts, the straps to extend through bar-iron plates, to be secured at bar-iron side supports and at pipe standards, as shown by details on drawing No. P. P. 407.

Pipe Trenches.

269. Pipe trenches of concrete, of dimensions given on drawings, are to be constructed by this contractor below the engine-room floor, for the exhaust and drip pipes from engines and for the connections to air compressors and vacuum pump. These trenches are to have 9-inch-thick walls as shown and to be covered with $1\frac{1}{2}$-inch-thick slabs of hard Alberene stone. The cover sections are to be 6 inches wider than width of trench, resting 3 inches on side walls. The remaining 6 inches of each side wall is to be covered with $1\frac{1}{2}$-inch-thick slabs of the same stone, forming a border against which the cement floor, which is not included in this contract, is to be finished, the top surfaces of the covers and border plates being set exactly flush with the finished floor line.

270. The cover and border sections of plates are to be of uniform thickness, with smooth even unpolished surfaces. Sections to be of suitable length, having straight, square edges and ends, so as to make neat, close, butt joints.

Valves.

271. Valves are to be provided on all piping where shown on the drawings or herein specified, or where necessary for the proper operation of the system, in accordance with the intent of this specification.

272. All valves on the heating mains, including those on circulating pumps, water heaters, and by-pass connections, on exhaust-steam piping, on high-pressure steam loop, the auxiliary valves at boiler outlets and on engine connections, on cold and hot water mains, including cold-water pump connections and on all mains in tunnels and at connections to buildings, on return connections from water heaters, on all tin-lined pipe except on boiler-feed piping and on gas piping, are to be double noncorrosive-seat gate valves.

273. All other valves, unless otherwise specified, to be globe or angle valves, having elastic movable disks.

274. Valves 4 inches diameter or larger, except valves on exhaust piping and on connections to water heaters of heating apparatus, in pump and heater room, are to have outside yokes and rising spindles, designed to be packed under pressure. The valves for the exhaust

piping and on connections to water heaters are to have inside screws with stationary spindles. Valves on high-pressure piping are to be extra heavy, designed for working pressure of 250 pounds per square inch, and all other valves are to be of heavy pattern, designed for 150 pounds per square inch working pressure.

275. Valves 2 inches in diameter and smaller to be constructed of best quality steam metal with screw ends, and those $2\frac{1}{2}$ inches diameter and over to have flanged-iron bodies with brass mountings.

276. The gate valves specified for distilled-water piping are to be tin-lined and those on high-pressure steam piping, $2\frac{1}{2}$ inches diameter or larger, are to have removable bronze seats.

277. Globe valves, $\frac{3}{4}$ inch in diameter, with hose nipples or $\frac{3}{4}$-inch hose valves, are to be provided at all points where drips are required.

278. Floor stands, of cast iron with brass trimmings and indicators, are to be provided and placed on the engine exhaust valves as indicated.

Check Valves.

279. Heavy-pattern brass swinging check valves are to be provided on the immediate boiler-feed connections, on the discharge from the injector, boiler-feed, cold-water, and catch-basin pumps, and on all trap-discharge connections. All check valves, except those for low-pressure trap-discharge connections, are to be designed for a working pressure of 200 pounds per square inch.

Air Valves.

280. Where indicated on the drawings, and at the highest points of water and steam piping in the pump and heater room, and on all tanks and heaters, approved-make, key, finished-brass, nickel-plated aircocks are to be provided. For each of the direct radiators in the power house a first-class and approved-make automatic air valve is to be furnished and placed.

Radiator Valves.

281. The valves for the direct radiators must be of angle pattern, brass, nickel-plated all over, of first-class and approved construction, having removable elastic disks, wood wheels, and union connections.

Back-pressure Valve.

282. On the exhaust main above the feed-water heater a vertical, flanged-pattern, 16-inch-diameter, double-seated, weighted back-pressure valve, having iron body with brass trimmings, is to be placed.

Relief Valves.

283. Two 2-inch-diameter, heavy-pattern, brass, water relief valves, to operate at a pressure of approximately 60 pounds per square inch, are to be provided, one on the expansion tank relief connection, and one on the supply connection to the hot-water tank.

Pressure-regulating Valves.

284. On the connections from the high-pressure steam main in pump and heater room, one 6 by 12 inch and one 5-inch pressure-regulating valve are to be provided, the former to furnish an auxiliary supply to water heaters at approximately 2 pounds pressure per square inch, and the latter to furnish steam at approximately 40 pounds pressure per square inch.

285. A 2½-inch reducing valve is to be provided on the water connection from cold-water main to hot-water storage tank, to reduce the pressure from approximately 60 pounds to 50 pounds per square inch, and a 3-inch reducing valve is to be provided on the compressed-air main, to reduce the pressure from approximately 60 pounds to 40 pounds per square inch.

286. The pressure-regulating valves are to be of heavy pattern, constructed with iron bodies, with brass trimmings, to be provided with weighted levers, diaphragms, and low-pressure connections. Valves on steam piping to be extra heavy, designed for 250 pounds working pressure.

Float Valve.

287. A 2-inch-diameter automatic supply valve is to be furnished and installed on cold-water connection to receiving tank to maintain a constant water line. Automatic supply to have balanced valve, large-sized copper float, lever, etc., inclosed in a casing outside of receiving tank, arranged so that the valve, float, etc., may be easily removed without disconnecting the water connections.

Thermostatic Valve.

288. A thermostatic valve is to be furnished and installed in the hot-water tank, this valve to control the operation of a diaphragm valve on the steam connection to the hot-water heater. The diaphragm valve is to be placed beyond the hand-control valves on the steam connections to the heater and is to be operated by compressed air, the compressed-air connection being run from the outlet indicated, in the compressed-air piping.

Thermometers.

289. Eighteen first-class mercurial thermometers, in polished-brass frames, with protectors for the thermometer tubes, are to be

furnished and installed in suitable thermometer cups, located in special fittings, except on piping larger than 4 inches in diameter, in which cases fittings may be tapped for the thermometer cups.

290. Thermometers are to be placed on the following connections: One on the 8-inch-diameter return main from each building, one on the 10-inch-diameter flow main at entrance to tunnels, one on both inlet and outlet connections to each of the four water heaters of the heating apparatus, one on both inlet and outlet connection to hot-water tank, one on the distilled-water connection, one on the cold-water supply and one on the overflow connections to the distilled-water condensers, one on the pump-suction connection from receiving tank and one on the discharge connection of the blow-off tank. The exact location of thermometers to be as directed by the mechanical engineer.

Gauges and Gauge Board.

291. The gauges as given below are to be mounted on a suitable size gauge board, of material selected for switchboard, 1½ inches thick, finished and polished and having beveled edges; gauge board to be secured by suitable iron brackets, where indicated, in engine room.

292. The gauges of first-class and approved construction are to be as follows: One clock with 10-inch-diameter dial; one high-pressure steam gauge, graduated to 200 pounds per square inch, 8½-inch dial; one medium-pressure steam gauge, graduated to 100 pounds pressure per square inch, 8½-inch dial; one combination steam gauge, graduated 15–0–15 pounds per square inch, 8½-inch dial; one cold-water gauge graduated to 120 pounds per square inch, 8½-inch dial; one air-pressure gauge, graduated to 120 pounds per square inch, 8½-inch dial; and two vacuum gauges, 8½-inch dial, one gauge being connected to vacuum-cleaning piping.

293. In addition to gauges, on gauge board, the following gauges, having 6¾-inch diameter dials, are to be furnished and placed on tanks or piping, as directed: One medium-pressure steam gauge, graduated to 100 pounds per square inch; one combination steam gauge, graduated 15–0–15 pounds per square inch; four water gauges, graduated to 120 pounds per square inch; and one air-pressure gauge, graduated to 80 pounds per square inch.

294. All gauges are to have iron cases with brass nickel-plated rims, and to be provided with noncorrosive movements. Connections to all gauges, including piping, gauge cocks, siphons, drips, etc., to be run as directed, and all exposed piping in engine room and siphon and drip connections to be brass, nickel-plated.

295. Drawings in duplicate of gauge board, showing arrangement of gauges, connections, etc., must be submitted and approved before the board is constructed.

296. This contractor is to furnish a Crosby, or equal, pressure-gauge tester complete, with weights for testing to 200 pounds.

Exhaust Head.

297. Where shown on the exhaust main above roof, a 16-inch-diameter, approved-make, heavy-pattern, galvanized-iron exhaust head is to be provided, having flanged connection to exhaust riser.

298. Drip from exhaust head is to be carried down into pump and heater room and connected to the drain running to catch-basin.

Radiators.

299. Where indicated in the rooms on engine-room floor, cast-iron radiators, of standard and approved make of the height, number of columns, and containing the number of square feet of radiating surface noted on plans, are to be furnished.

300. Radiator connections are to be provided with suitable sleeves where same pass through floors and with cast-iron nickel-plated floor plates around connections properly fastened in place.

301. Radiators and immediate connections are to be finished with two coats of best quality aluminum bronze.

Pipe Coverings.

302. All high and medium pressure, exhaust-steam, steam-drip, hot and cold water, and hot-water piping of heating apparatus in power house and in tunnels to be covered with asbestos fire felt, or equal, coverings, except cold-water piping, which is to be covered with approved felt coverings lined with tar paper. Nickel-plated piping and pipes on boiler fronts are not to be covered.

303. Coverings for all high-pressure and all 4-inch-diameter or larger medium-pressure steam piping, and for all flow and return piping of heating system, are to be not less than $1\frac{1}{2}$-inch-thick coverings. All other coverings to be 1 inch thick, except cold-water pipe covering, which is to be $\frac{3}{8}$ inch thick.

304. Special molded coverings are to be provided for all valves and fittings.

305. All coverings are to be provided with canvas jackets and are to be secured in place with solid brass bands, not less than No. 30 B. W. G., 1 inch wide for all pipe 5 inches diameter or less and $1\frac{1}{4}$ inches wide for all pipe over 5 inches in diameter, the bands being placed 18 inches apart.

SECTION VIII.—ELECTRICAL EQUIPMENT.

GENERATORS.

Requirements.

306. This specification is to provide, complete in every detail, electrical generators of the latest and most approved design, to be direct-connected to either the turbines or reciprocating engines, hereinbefore specified.

Type and Number.

307. There are to be furnished three compound-wound, multipolar, direct-current generators, to operate on a 2-wire 220-volt system, the generators being wound for 230 and 240 volts.

Ratings.

308. The generators must be capable of developing and delivering at the switchboard, when operating under normal conditions, their full rated output.

309. They must also be capable of carrying a 30 per cent overload for two hours and 50 per cent overload momentarily, without injurious sparking.

310. Two of the generators are to have a rating of 150 kilowatts and the third 75 kilowatts, based on fixed shunt field excitation, when running at speeds specified for turbines or engines continuously for a period of twenty-four hours, without excessive sparking, overheating, etc.

Commercial Efficiencies.

311. Bidders must state on their proposal sheet the guaranteed commercial efficiencies of the generators of both the turbine and engine installation when running at $1\frac{1}{4}$ load, full load, $\frac{3}{4}$ load, $\frac{1}{2}$ load, and $\frac{1}{4}$ load.

Heating Effects.

312. The rise in temperature of any part of the generators must not exceed the temperature of the air surrounding the machine by more than 40° C. after a continuous run of twelve hours under full-load conditions, the temperature of the air not exceeding 25° C., and, under the same conditions with 30 per cent overload, the rise in temperature on no part to be more than 55° C. above the surrounding air after a run of two hours made immediately after the full-load run.

Over-compounding.

313. The machines must be arranged for over-compounding from a no-load voltage of 230 volts to 240 volts, the over-compounding being accomplished in the most approved manner, without requiring the readjustment of the shunt field rheostat.

Tests.

314. Shop tests of the three generators are to be made for determining the commercial efficiencies at the various loads, the heating effects, over-compounding, etc. The machines, under these tests, must be run under actual operating conditions.

315. The generator windings must be capable of withstanding 2,000 volts alternating current for one minute, and the insulation resistance between any current-carrying part of the generators and frame must not be less than 1 megohm.

316. The contractor must notify the mechanical engineer when the generators are ready for test and must furnish all apparatus and appliances, etc., necessary for the tests, and pay all expenses incident thereto.

317. The shop tests may be omitted if desired by the mechanical engineer, and such tests of the generators, as may be deemed advisable by the mechanical engineer, be made after erection in the buildings.

Construction Details.

318. The three generators must be so constructed that they will operate perfectly in parallel under any change or condition of load.

319. All parts of the generators shall be of heavy pattern and design, and constructed of materials best adapted for the various parts and in accordance with the most modern practice.

320. The frames are to be constructed of best quality soft cast iron.

321. The armature must be well balanced, both electrically and mechanically, well ventilated, and easily removable. It is desired that the armature be of the slotted-drum type. No joints are to be made in armature windings except at connections. Commutators must be of drop-forged or hard-drawn copper, of highest conductivity, insulated with mica sheets of even thickness and having ample surfaces for brushes, and provision for wear.

322. Brush holders are to be constructed in a manner to permit all necessary adjustments to be conveniently made and designed so that the brushes will not chatter.

323. The brush holders are to be secured to an approved form of yoke or brush-shifting device, which is to be arranged for locking to the frame.

324. The brushes are to be of carbon, having not less than 1 square inch of bearing surface for every 35 amperes of current, or

of an approved composition of carbon and copper having a carrying capacity as may be approved by the mechanical engineer for the particular brush desired to be used.

Fittings.

325. The terminal boards at the machines to be of material and finish specified for switchboard, to be of ample size for the connections and lugs, 1½ inches thick, and finished with beveled edges.

326. A full set of drop-forged, single-ended, steel wrenches, to fit all the various parts of the machines, is to be furnished and placed on the rack for engine wrenches, herein specified.

Specifications and Drawings.

327. Bidders must state in their proposal the make of generators upon which their proposal is based, and must submit, before the award of the contract, complete detailed specifications and drawings covering all parts of the machines.

SWITCHBOARD.

Requirements.

328. The intent of this specification is to cover, complete in every detail, including panels, instruments, switches, etc., the switchboard as shown by drawing No. P. P. 410.

Size of Switchboard.

329. The switchboard is to consist of three generator panels, two station panels, and two feeder panels.

Panels, etc.

330. Panels to be of hard Alberene stone, 2 inches thick finished and polished, 26 inches wide by 5 feet high for the upper sections and 26 inches wide by 2 feet high for the lower sections, all sections having ⅜-inch beveled edges.

331. Slabs must be free from metallic veins and dark streaks, must be true and square, to have smooth, even surfaces and edges fitting closely together.

332. The terminal slabs, resting on the framing, and the fuse block back of the feeder panels are to be of material of panels, 1½ inches thick, 8 inches wide, and of the required lengths.

333. Bidders are also required to state in their proposals an amount to be added to or deducted from the amount of their proposal, if panels are constructed of 2-inch-thick highly polished blue Vermont marble.

Framing.

334. The panels are to be supported by 2 by 2½ inch angle-iron frames extending from the ½ by 4 inch floor plate to the ½ by 2½ inch

top plate, the angles being secured at floor and top plates with metal corners bolted to the angles and fastened rigidly to the floor by heavy expansion bolts passing through the iron floor plate.

335. The feeder panels are to be braced from the walls by four $2\frac{1}{2}$-inch angles bolted to the vertical angle frame and built solidly into the brick wall. These angles are also to serve for supporting the feeder terminal slab, as indicated, the slab being held in place by 1 by $\frac{1}{4}$ inch bar-iron straps and 2 by $2\frac{1}{2}$ inch corner angles bolted in place.

336. For securing the ends of the feeder conduits at top of board two 2 by $1\frac{1}{2}$ inch angle irons are to be bolted across angle-iron wall braces, the conduits being strapped at the top of these angles by $\frac{3}{8}$-inch round iron straps extending between the two angles provided with washers and nuts below the bottom flanges of the angles.

337. The fuse blocks back of feeder panels are to be secured by 2-inch angles bolted to blocks and to vertical angles of frame.

338. The entire frame is to be bolted together in an approved substantial manner with $\frac{5}{8}$-inch-diameter hexagonal bolts with washers and nuts.

339. The bolts securing panels to frame to have hexagonal acorn cap nuts, finished brass, copper-plated.

340. Rubber washers are to be placed between panels and iron frames to prevent unequal pressure on panels, when same are bolted in place.

341. All angles, straps, bolts, etc., used in the construction of the switchboard must be properly painted with a noncorroding compound and given a smooth, even surface.

Bus Bars, Fittings, etc.

342. All bus bars and branch connections are to be placed on the back of the board, arranged approximately as shown by diagrams on drawing No. P. P. 410.

343. The bus bars, also switch blades, washers, etc., are to be stamped, rolled, or forged copper of highest conductivity, accurately shaped, cut square and true to size.

344. All metal parts on front of board are to be highly polished and lacquered.

345. Fuse studs, bolts, etc., may be of brass, but if so, they must have a cross-sectional area in proportion to its conductivity, and be heavily copper-plated to match finish of copper parts.

346. The current density of all bus bars and current-carrying parts of the switchboard must not be over 800 amperes per square inch. The main bus bars and branch connections are to be of sizes shown by diagram. The feeder branches from bus bars to feeder terminal boards are to be of solid copper wire or bars, as indicated.

347. The spacing of bus bars, studs, etc., must conform in every particular with the requirements for such work as set forth in the latest edition of the National Electrical Code.

348. All bolted or screwed connections with the bus bars, etc., must have a carefully fitted contact surface of not less than 1 square inch for 150 amperes of current. Such connections must be made with copper washers with lock nuts or washer nuts.

349. All switch, fuse, and instrument studs are to be firmly bolted to panels with bolts having hexagonal nuts and washers.

350. Cup lugs of cast copper of required sizes for feeders are to be provided for all feeder connections.

351. The bus bars are to be supported in an approved manner on heavy cast-iron brackets, securely bolted to the angle-iron frame of switchboard. Bus bars are to rest on porcelain blocks or other approved insulators, which are to be placed on the cast-iron brackets.

352. All instrument leads, wiring for instrument lamps, etc., on the rear of switchboard, to be rubber-covered, of ample carrying capacity, run as directed and held in place to the switchboard by hard-rubber, fiber, or porcelain cleats secured to lead plugs in board by brass screws.

Switches.

353. The switches on the three generator panels to consist of two 750-ampere and one 400-ampere, three-pole, double-throw switches.

354. The switches on station panels to consist of two 1,500-ampere, double-pole, double-throw, and one 800-ampere, double-pole, single-throw switches.

355. On the two feeder panels, four 800-ampere, three 200-ampere, three 150-ampere, and eight 50-ampere, double-pole, single-throw switches are to be provided.

356. All switches are to be of knife pattern, constructed for 220 volts.

357. The feeder switches, except the 800-ampere switches, are to be provided with fuse studs for nonarcing cartridge fuses on face of board.

358. All switches to be of pure drawn copper having sufficient thickness of metal for stiffness, designed so that at full load the current density will not exceed 800 amperes per square inch in the blades and 75 amperes per square inch at all bearings.

359. Hinges are to be provided with spring washers so that switches will be held firmly in any position.

360. Switches, handles, and bridges are to be of hard rubber or nonabsorbent black fiber.

Circuit-breakers.

361. The three circuit-breakers on the generator panels are to be of carbon-break laminated type, double pole, operated by a single handle. Two of the circuit-breakers to have an actual rating of 800 amperes and the third an actual rating of 400 amperes. Each breaker to be calibrated for a capacity of approximately 25 per cent below and 50 per cent above actual rating.

362. Circuit-breakers to be provided with back connections as indicated.

Fuses.

363. All feeder circuits, except feeders controlled by 800-ampere switches, are to be protected by nonarcing cartridge fuses placed on the face of the panels, as indicated. Fuses to be provided with copper-plated caps and clips and black ferrules.

364. The four large feeders are to be protected by open-type link fuses mounted on the fuse block back of board.

365. Two complete sets of fuses are to be provided for all circuits.

Rheostats.

366. The three generator rheostats are to be securely fastened to the rear of the switchboard, having finished copper-plated operating wheels not less than 6 inches in diameter, with indicating dial, arranged to be operated from the front of the switchboard. The rheostats are to be fireproof, shunt-field, regulating rheostats of approved make.

Ground Detector.

367. The voltmeter at the end of the switchboard shall be used as a ground detector and shall be connected up to the points provided for this purpose on the voltmeter switch.

368. The ground connections shall be made as directed, suitable connections being made to a drainpipe running below engine-room floor approximately below position of the switchboard.

Voltmeter Switch.

369. The voltmeter and ground detector switch to be of the type having connections mounted on back of switchboard operated by copper-plated wheel on front of board equipped with plate and pointer to show position of switch. The points of switch to be marked on plate by letters to indicate circuits. All contacts to be rubbing contacts of ample capacity and pressure to insure a permanent connection of such low resistance that no error will be thereby introduced into the reading of the voltmeter.

370. Four voltmeter plug receptacles of approved type with four sockets are to be provided where indicated on switchboard. Two plugs of suitable type and finish are to be furnished.

Instruments.

371. The switchboard is to be furnished with five ammeters and three voltmeters, all of which, except the voltmeter at end of switchboard, are to be Weston Illuminated Dial Model A, flush-type station instruments, the voltmeter at end of board being of same make but Model B.

372. For this latter voltmeter an approved-type, heavy-pattern, swinging, metal bracket is to be provided, securely bolted to switchboard frame, the voltmeter being properly supported from bracket.

373. The instruments are to have the following scale: Ammeters—two 0 to 1,500 amperes, two 0 to 750 amperes, one 0 to 400 amperes; voltmeters—two 0 to 250 volts, one 250–0–250 volts.

374. The instruments are to have copper-plated finish for borders and for raised parts of cases, the remainder of the cases to have black finish.

375. The instruments are to be arranged on switchboard as indicated and securely fastened in place.

376. Ammeters to have suitable shunts connected to bus bars as indicated by diagram.

377. All wiring, lamps, etc., for the illumination of the instruments to be furnished complete and installed, as directed.

378. Two Thompson high-capacity astatic recording wattmeters, having maximum recording capacity of 1,500 amperes at 220 volts, are to be furnished and secured to station panels of switchboard, where indicated. Meters to be arranged for back connections, to have copper-plated finish and glass cases.

Designation of Circuits.

379. Each of the feeder circuits is to be provided with a suitable size neat fiber plate secured to board with copper-plated fastenings, the fiber plates to have circuit numbers or letters cut into them, the figures or letters being filled in with white paint.

380. On the lower sections of the feeder panels directories of the various feeder circuits are to be provided. These directories are to be engraved on copper plates of suitable dimensions, properly finished and secured to panels; the letters to be finished black.

Drawings and Inspection.

381. Contractor must submit for approval, in duplicate, complete working drawings of the switchboard showing all details of construction, spacing and size of bars, switches, etc., which drawings must be approved by the mechanical engineer before the switchboard is constructed.

382. Shop inspection of the switchboard after completion is to be made, and contractor must notify the mechanical engineer when

switchboard is ready for such inspection. This inspection may be omitted if so desired by the mechanical engineer.

MOTORS.

Requirements.

383. All motors required under this contract for air compressors, pumps, and draft fan are to be of approved manufacture, designed for 220 volts direct current and of semi-inclosed type.

384. Motors for air compressors, vacuum pump, cold-water pumps, and circulating pumps are to be provided with iron bedplates, mounted and firmly secured to the extended base of the compressors or pumps. The motor for the catch-basin pump to be of vertical type and to be properly and securely supported on pump shaft. The fan motor is to be mounted on a brick pier and to be provided with an iron bedplate.

385. Motors for cold-water pumps, catch-basin pump, and circulating pumps on heating apparatus to be attached to pump shafts by insulated and flexible flanged couplings of approved construction, allowing independent alignment of motor and pump shaft, while the motors of air compressors, vacuum pump, and draft fan are to have silent chain drives, the chains in each case being provided with suitable guards.

Ratings.

386. The motors for the air compressors, vacuum pump, cold-water pumps, circulating pumps, and catch-basin pump must be of ample capacity to comply with the requirements, as herein specified in detail, for the different appliances.

387. The motor for the draft fan must have not less than 10 brake horsepower capacity when running at maximum efficiency.

Efficiencies.

388. Bidders must state on their proposal sheets the guaranteed efficiencies of each motor at full load, $\frac{3}{4}$ load, $\frac{1}{2}$ load, and $\frac{1}{4}$ load, the speed and guaranteed horsepower at full load, and the make of each motor.

Regulation.

389. Motors must be of design to be capable of speed control by shunt field resistance only from full-load speed to half full load and intermediate speeds.

390. At the lower speeds the motors must run within the same condition of heating limits and sparkless operation as are specified for the higher speeds.

Heating.

391. All motors must be capable of carrying their full loads continuously without a rise in temperature of any part more than 40° C. above the temperature of the surrounding atmosphere, and 25 per cent overload for one hour without injurious heating.

Construction Details.

392. Commutation must be practically sparkless at all conditions of speed and load, within the limits specified.

393. Armatures must be of tooth-core construction, with coils wound in mica-insulated slots, the windings thoroughly insulated and firmly secured in place.

394. Armatures must be well balanced electrically and mechanically, well finished and easily removable.

395. Commutators must be of drop-forged or hard-drawn copper, of highest conductivity, insulated with mica of even thickness and having ample bearing surface for brushes, and provision for wear.

396. Brushes are to be of carbon, mounted on common rocker arms, and to have cross-sectional area of not less than 1 square inch for each 35 amperes of current, or of an approved compound of carbon and copper having carrying capacity as may be approved by the mechanical engineer for the particular brush desired to be used.

397. Brush holders are to be constructed in a manner to permit all necessary adjustments to be conveniently made, and designed to prevent chattering of brushes.

398. Frames to be of the best grade soft cast iron or steel of highest permeability.

Tests.

399. The horsepower, efficiencies, heating effect, insulation resistance, etc., of all motors must be determined by actual tests made at the shops where the motors are constructed in the presence of the Department's authorized agent, who shall determine the test conditions. The tests must also show an insulation resistance from field coils, armature windings, and brushes of not less than 1 megohm.

400. Motors must be capable of standing a breakdown test of not less than 1,500 volts alternating current for one minute.

Motor Panels.

401. The air compressors, vacuum pump, and cold-water pumps are to be provided with controlling panels as designated as type D on drawing No. P. P. 408, having mounted thereon two 4-pole double-throw knife switches, one hand-operated combination starting and regulating rheostat with underload and overload release, and one

automatic starting device consisting of pressure regulator, solenoid switch, and solenoid rheostat.

402. The two circulating-pump motors are to be furnished with a controlling panel designated as type C on drawing No. P. P. No. 408, having double-pole, 100-ampere, 220-volt switches and combination starting and regulating rheostats.

403. The panels of types C and D are to be of material of switchboard, of dimensions given, 2 inches thick, with $\frac{3}{8}$-inch beveled edges, being securely supported to $1\frac{1}{4}$-inch wrought-iron pipe standards, as shown by the drawings, finished as specified for other ironwork.

404. The air-compressor motor panel is to be furnished with 100-ampere 220-volt switches, and pressure regulator to be adjusted to operate compressors to maintain approximately a pressure of 60 pounds per square inch.

405. The vacuum-pump motor panel is to be provided with 75-ampere 220-volt switches, and the pressure regulator is to be suitable to operate pumps to maintain approximately 26 inches of vacuum.

406. The switches for the cold-water pump motor panel are to be 50-ampere 220-volt switches, and the pressure regulator is to be suitable for operating motors to maintain a pressure of approximately 60 pounds per square inch. A 25-ampere 220-volt switch is to be mounted on this panel, as indicated.

407. The motor for the catch-basin pump is to be controlled by an automatic starting rheostat with overload and underload release, designed to be operated by a ball float to be placed in the catch-basin, herein specified. Arrangement must be provided so that rheostat may be operated by hand. All necessary chain, pulleys, weights, and a 5-inch-diameter copper ball float are to be furnished and properly connected. The rheostat, with a 25-ampere 220-volt knife switch, is to be mounted on a suitable size tablet securely supported in place by bar-iron braces on wall, where indicated.

408. For the control of the draft fan an approved-make pressure-regulating valve arranged to operate, by a slight variation in the steam pressure, the motor controlling rheostat, is to be provided and installed complete with all necessary connections to regulator and operating mechanism. The rheostat is to be furnished with an overload and underload release, and the rheostat, together with the pressure regulator and a 75-ampere 220-volt knife switch, is to be mounted upon a suitable size tablet securely supported from wall, where indicated. Bidders are required to state in their proposals the amount to be deducted from their total proposals if the pressure regulator with its connections, including the connection to motor rheostat, is omitted, the motor being provided simply with the hand-control rheostat of type specified.

409. All rheostats for the various panels are to be of first-class and approved manufacture.

410. Tablets to be placed on walls are to be so located as to allow easy access to all connections.

411. All connections to be made at rear of tablets.

412. The connections for the type C and D panels are to be made as shown by the diagrams.

413. Bus bars, studs, switches, lugs, etc., to be of carrying capacity, material, finish, etc., as herein required for switchboard construction.

414. The current-carrying parts on the different panels to be based on the rated capacity of the respective switches.

415. Material for all panels to be as required for switchboard, the small panels being $1\frac{1}{2}$ inches thick with $\frac{3}{8}$-inch beveled edges.

416. After the award of the contract, the contractor must submit, in duplicate, for the approval of the mechanical engineer, complete detailed drawings of all motor tablets, showing size, arrangement, etc. Tablets are not to be constructed until drawings of same have been approved.

417. All pipe connections to pressure regulators of the different automatic starting devices are to be included in this contract. Piping to be of ample size, provided with necessary valves, stopcocks, drips, etc., to be run as directed, and all pipes, etc., exposed in engine room are to be finished brass nickel-plated.

APPLIANCES, ETC.

Lighting Tablets and Cabinets.

418. The two distribution tablets, one to be located in engine room and one in boiler room where indicated, are to be arranged as shown by diagrams on drawing No. P. P. 408, for two-wire feeders and two-wire branch circuits, each circuit being provided with a 25-ampere double-pole knife switch of rigid construction, highly polished and lacquered, provided with fiber crossbar and handles, or approved-make composition-fiber spool handles and cartridge-type nonarcing fuses of capacity to protect the smallest wire on the circuit, provided with clips to be secured to fuse studs with set screws.

419. The main bus bars are to be placed on the back of the boards, and all cross-over bar connections for the different circuits to be placed on the front of the boards. Main bus bars and connections are to be of 50 amperes capacity, and branch connections of capacities equal to the switch ratings.

420. Bus bars, switches, lugs, etc., to be of carrying capacity, material, finish, etc., as required for switchboard, and material of tablets to match that of switchboard construction and to be $1\frac{1}{4}$ inches thick.

421. Circuits of tablets are to be designated by numbers stamped on black fiber plates secured to tablets with copper-plated fastenings, the numbers being finished with white paint.

422. The tablets are to be provided with approved-make metal cabinets of heavy pattern, strongly framed and lined with $\frac{3}{4}$-inch-thick slabs of material of tablets, securely fastened to metal boxes with machine screws arranged to form wiring compartments, as indicated. The tablets are to be supported out from back of box on a 1-inch angle-iron frame, to which they are to be fastened with machine screws.

423. Cabinet of tablet B in boiler room is to be securely fastened to face of wall with heavy expansion bolts and provided with a solid tight-fitting metal door with heavy-pattern hinges and catch.

424. The cabinet in engine room is to be set into the partition and provided with an ornamental metal door, with trim of neat design, the door being furnished with a large-size beveled plate-glass panel, suitable hinges and catch. The trim of panel is to project beyond the edges of cabinet and to be set flush with the plaster line.

425. All metal parts of cabinet are to have a smooth, even finish of a black noncorrosive compound.

Cables.

426. The generator leads connecting from machine terminal boards to switches on switchboard are to be flexible, rubber, insulated and braided cable, the leads from the 150-kilowatt units to consist of three 1,200,000 c. m. cables and from the 75-kilowatt unit of three 600,000 c. m. cables.

427. The four cables from the switchboard in power house to each of the two switchboards in the laboratory buildings are to be of standard, lead-covered, paper-insulated, 600,000 c. m. cables. The distance from the ends of tunnels to the switchboard in each laboratory building is 180 feet.

428. Bidders are required to state in their proposal the amount to be deducted from total proposal if slow-burning weatherproof or varnished cambric 600,000 c. m. feeder cables are installed, in lieu of the lead-covered paper-insulated cables here specified.

429. No joints will be allowed in the generator leads, and joints in feeder cables can only be made where and as approved.

430. The generator leads and the main-feeder cables to the laboratory buildings from switchboard to face of wall in pump and heater room are to be run below the engine-room floor in conduits of best quality cold-drawn steel tubing enameled inside and outside, the conduits being of ample-size and provided at ends with bushings, long-turn elbows being used at all bends. The conduits at machines and switchboard are to terminate just above the floor line.

431. The feeder cables to switchboards in the laboratory buildings are to be supported in place by approved-make cast-iron racks, secured in place by heavy expansion bolts, the racks being provided with porcelain blocks for clamping the cables in place. The racks are to be suitable for six cables and are to be placed on run 6 feet apart. The cables in laboratory buildings to be run, as directed, at ceilings of sub-basements.

Wiring.

432. This contractor is to install a complete conduit and wiring system for the lighting of the power house and tunnels and for power feeder connections from the switchboard to the various motor tablets and from tablets to motors.

433. Approved steel conduits, of sizes indicated or necessary for the proper insertion of the wires, are to be run as indicated on the plans, all conduits from switchboard being run below engine-room floor. Conduits provided with iron fish wire are to be installed from switchboard to the wall of pump and heater room for the extra circuits of switchboard. Conduits are to be securely fastened in place in an approved manner throughout their entire runs.

434. Suitable hangers must be provided at outlets for securely supporting fixtures.

435. The terminals of all conduits to be provided with locknuts and terminal bushings of approved pattern with rounded edges.

436. Pressed-steel outlet boxes of approved type, properly placed, are to be provided at each fixture outlet unless otherwise specified.

437. On the circuits in tunnels, in coal pocket, and at wall outlets in boiler-room conduit, receptacle outlet fittings are to be installed, except at outlets for two lamps, where fittings for fixtures are to be placed.

438. Where indicated on the plans, approved-make, double-pole, push-button snap switches of 10 amperes capacity for 220 volts are to be placed in special conduit fittings.

439. Approved steel or cast-iron pull boxes are to be installed on all runs where necessary for drawing in the wires.

440. All wiring for lighting and power circuits is to be provided, installed complete, from switchboard to all lighting outlets and to all motors, the wiring being run in conduits as herein provided.

441. Conductors to be rubber-covered, made in accordance with the National Electric Code standards, and to have distinctive markings. Wiring No. 8 B. & S. gauge and larger to be stranded, and no wire smaller than No. 14 B. & S. gauge is to be used.

442. Feeders and branch-circuit conductors must not be less than the sizes, B. & S. gauge, noted on the plans.

443. No joints will be allowed in circuits except at junction points, where wires are to be properly twisted together and joints soldered and well taped.

444. Feeder connections must in all cases be made by soldering conductors into cup lugs.

445. Wiring in tunnels must be so installed that the circuit in each section of the tunnel can be controlled from the snap switch at either end of the section.

Arc Lights.

446. In the engine and boiler rooms, where indicated, 220-volt direct-current arc lights, six in all, of approved make, with inclosing opaque glass globes and black enameled cases, are to be furnished and securely supported in place approximately 10 feet above the floor of engine room and 15 feet above floor in boiler room, lamps being so arranged that they may be lowered.

SECTION IX.—GENERAL REQUIREMENTS.

Excavating.

447. This contractor must do all necessary excavating and backfilling, and repair, to the satisfaction of the District authorities, streets and sidewalks where service connections are to be made to the gas and water mains. All necessary excavating must also be done for engine, air compressor, vacuum pump, and boiler foundations and for pipe trenches, all excess earth being removed from the premises.

Masonry Work.

448. All brick for engine, pump, pump-motor, and tank foundations, etc., are to be selected hard-burned red brick of uniform size.

449. Brickwork, unless otherwise specified, to be laid with close joints, in cement mortar composed of 1 part best quality Portland cement to 2 parts clean, sharp sand. All outside joints are to be struck.

450. The concrete of pipe trenches and for footings to be of 1 part best quality Portland cement to 3 parts clean, sharp sand and 6 parts broken stone, of size to pass through a 2-inch-diameter ring.

Painting.

451. All boiler-setting trimmings, including fronts, all pipes, hangers, and all other ironwork and appliances, unless otherwise specified, to be painted with one coat of best quality red lead and linseed oil, and all work not to be covered to be given two additional coats, having approved colorings.

452. The engines, generators, air compressors, and vacuum pump with motors are to be properly finished as required by the mechanical engineer. All unfinished surfaces of castings must be properly filled and rubbed to a smooth, even surface, with not less than two coats of best oil paint, ready for the finishing coat of selected varnish. Brickwork of all foundations in engine room is to be painted with three coats of best quality white lead and oil paint, colored as may be approved.

453. Finishing color, striping, etc., to be as approved.

454. All coverings for tanks, heaters, pipes, etc., are to be painted with two coats of best quality asbestos paint of selected colors. Covering bands to be painted where directed by the mechanical engineer.

PROPOSAL FOR POWER PLANT EQUIPMENT OF THE NEW BUILDINGS FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

N. B.—After these proposal sheets have been filled out by the bidder they must be detached from the specification and forwarded under separate cover with postage prepaid by the sender.

Bidders are notified that lump-sum proposals for the entire work must be submitted and that proposals for only portions of the work will not receive consideration. The various amounts, names of appliances, materials, etc., on proposal sheets are requested to be typewritten.

.....

To the SECRETARY OF AGRICULTURE,
Washington, D. C.

SIR:

PROPOSAL A.

455. ..... hereby propose to furnish all the labor and materials to install complete the entire power plant equipment of the new buildings, for the United States Department of Agriculture, furnishing steam turbines as required by paragraphs 48 to 67 of the specification, all in accordance with the drawings and specifications,

for the sum of .....

..... ($.....)

Make of steam turbines upon which proposal is based, ...

.....

PROPOSAL B.

456. Same as Proposal A except that engines, as required by paragraphs 69 to 103 of the specification, are to be furnished in lieu of

steam turbines, ...

..... ($.....)

Make of engines upon which proposal is based, ...

.....

PROPOSAL C.

457. Same as Proposal A except that steam turbines, as required by alternate proposal as stated in paragraph 68, are to be furnished,

.....

..... ($.....)

Make of steam turbines upon which proposal is based, ...

.....

PROPOSAL D.

458. Same as Proposal A except that engines, as required by alternate proposal as stated in paragraphs 104 and 105, are to be furnished, ...

..... ($.....)

Make of engines upon which proposal is based, ...

.....

459. Amount to be deducted from Proposal A for the omission of the entire engine and generator equipment with their connections and the three generator panels of switchboard, ...

.....

..... ($.....)

460. Amounts to be deducted from Proposals A, B, C, and D for the omission of one of the 150 k.w. generating units with connections complete, including the generator panel of switchboard:

(*a*) Deduct from Proposal A, ...

..... ($.....)

(*b*) Deduct from Proposal B, ...

..... ($.....)

(*c*) Deduct from Proposal C, ...

..... ($.....)

(*d*) Deduct from Proposal D, ...

..... ($.....)

161. Amount to be added to, or deducted from, the total proposals to cover the installation of the following alternate appliances:

(*a*) For internally fired boilers as per paragraphs 137 and 138 of the specification—

Add .....

..... ($.....)

Deduct .....

..... ($.....)

Make of internally fired boilers, ...

.....

(*b*) For water-tube boilers, as per paragraphs 137 and 138 of the specification—

Add .....

..... ($.....)

Deduct .....

..... ($.....)

Make of water-tube boilers, ...

.....

(*c*) For vertical type boiler-feed pumps, as per paragraph 160 of the specification—

Add .....

..... ($.....)

Deduct .....

..... ($.....)

Make of pumps, ...

.....

(*d*) For underfeed stokers, as per paragraph 144 of the specification—

Add .....

..... ($.....)

(*e*) For stokers, as per paragraph 145 of the specification—

Add .....

..... ($.....)

(*f*) For an additional vacuum pump, as per paragraph 166 of the specification—

Add .....

..... ($.....)

(*g*) For switchboard constructed of blue Vermont marble in lieu of Alberene stone, as per paragraph 333 of the specification, including motor panels, distribution circuit tablets, gauge board, and generator terminal blocks, which are specified to be of material of switchboard—

Add .....

..... ($.....)

Deduct .....

..... ($.....)

(*h*) For slow-burning weatherproof or varnished cambric cables, as per paragraph 428 of the specification—

Deduct .....

..... ($.....)

Make of cables, ...

.....

(*i*) For the omission of the pressure regulator in connection with controlling rheostat of the draft fan motor as required by paragraph 408 of the specification—

Deduct .....

..... ($.....)

(*j*) For the omission of the entire forced draft apparatus as required by paragraph 146 of the specification—

Deduct .....

..... ($.....)

462. Bidders must fill out the following blanks, giving names and addresses of manufacturers and other data called for relative to appliances, and, where appliances are not special, the trade name or catalogue number of the appliances, materials, etc., proposed to be used, with the understanding that the articles named must be in accordance with the specification requirements relative thereto and subject to the approval of the mechanical engineer:

Distilled-water apparatus, ...

.....

Shaking grates, ...

.....

Fan, ...

.....

Safety valve, ...

.....

Gauge column with water glass, ...

.....

Tube cleaner, ...

.....

Damper regulator, ...

.....

Injector, ...

.....

Boiler-feed pumps, ...

.....

Circulating pumps—make, ...; size, ...

.....

Cold-water pumps—make, ...; size, ...

.....

Catch-basin pump—make, ...; size, ...

.....

Air compressors—make, ...; dimensions, ...

.....

Vacuum pump—make, ...; dimensions, ...

.....

Vacuum receiver, ...

.....

Air receiver and after-cooler, make, ...

.....

Muffler tank and oil extractor, ...

.....

Feed-water heater, ...

.....

Hot-water heater, ...

.....

Separating traps, ...

.....

High-pressure traps, ...

.....

Tin-lined pipe, ...

.....

Packing for flanged joints,

Expansion joints,

Gate valves,

Globe valves,

Check valves,

Air valves,

Radiator valves,

Relief valves,

Blow-off valves,

Back-pressure valve,

Pressure-reducing valves,

Float valve,

Thermostatic valve,

Thermometers, ...

Pressure gauges, ...

Gauge tester, ...

Exhaust head, ...

Radiators, ...

Nonconducting coverings, ...

Steam-engine indicator, ...

Switchboard, ...

Motor panels, ...

Fuses, ...

Circuit-breakers, ...

Rheostats for motor panels, ...

Lighting tablets and cabinets, ...

Cables, ...

Rubber-covered wire, ...

Conduit, ...

Arc lights, ...

Turbine Data.

463. For turbines of Proposal A:

Make, ...

Revolutions per minute, { 150 k.w. unit, ...
75 k.w. unit, ...

Steam consumption in pounds of steam per kilowatt hour—

	1¼ load.	Full load.	¾ load.	½ load.	¼ load.
150 k.w.,					
75 k.w.,					

464. For turbines of alternate Proposal C:

Make, ...

Revolutions per minute, { 150 k.w. unit, ...
75 k.w. unit, ...

Steam consumption in pounds of steam per kilowatt hour—

	1¼ load.	Full load.	¾ load.	½ load.	¼ load.
150 k.w. unit,					
75 k.w. unit,					

Reciprocating Engine Data.

465. For reciprocating engines of proposal B:

Make, ...

.....

Revolutions per minute, { 225 brake h. p. unit, ... ; 113 brake h. p. unit, ... }

Steam consumption in pounds of steam per indicated horse-power per hour—

	1¼ load.	Full load.	¾ load.	½ load.	¼ load.
225 brake h. p. unit,	.....	.....	.....	.....	.....
113 brake h. p. unit,	.....	.....	.....	.....	.....

466. For reciprocating engines, alternate Proposal D:

Make, ...

.....

Revolutions per minute, { 225 brake h. p. unit, ... ; 113 brake h. p. unit, ... }

Steam consumption in pounds of steam per indicated horse-power per hour—

	1¼ load.	Full load.	¾ load.	½ load.	¼ load.
225 brake h. p. unit,	.....	.....	.....	.....	.....
113 brake h. p. unit,	.....	.....	.....	.....	.....

Generator Data.

467. For turbine installation, Proposal A:

Make, ...

.....

Commercial efficiencies in percentages—

	1¼ load.	Full load.	¾ load.	½ load.	¼ load.
150 k.w. unit,	.....	.....	.....	.....	.....
75 k.w. unit,	.....	.....	.....	.....	.....

472. Vacuum-pump motor:

Make, ...

.....

Guaranteed horsepower at full load, ...

Commercial efficiencies in percentages—

At full load, ...; ¾ load, ...; ½ load, ...; ¼ load, ...

473. Cold-water pump motors:

Make, ...

.....

Guaranteed horsepower at full load, ...

Commercial efficiencies in percentages—

At full load, ...; ¾ load, ...; ½ load, ...; ¼ load, ...

474. Circulating-pump motors:

Make, ...

.....

Guaranteed horsepower at full load, ...

Commercial efficiencies in percentages—

At full load, ...; ¾ load, ...; ½ load, ...; ¼ load, ...

475. Catch-basin pump motor:

Make, ...

.....

Guaranteed horsepower at full load, ...

Commercial efficiencies in percentages—

At full load, ...; ¾ load, ...; ½ load, ...; ¼ load, ...

476. Draft-fan motor:

Make, ...

.....

Guaranteed horsepower at full load, ...

Commercial efficiencies in percentages—

At full load, ...; ¾ load, ...; ½ load, ...; ¼ load, ...

(Signature) .....

(Address) .....

NAMES OF INDIVIDUAL MEMBERS OF FIRM.

.....

.....

NAME OF CORPORATION.

NAME OF SECRETARY.

NAME OF PRESIDENT.

UNDER WHAT LAW CORPORATION IS ORGANIZED.